AutoCal 2.2

User Manual

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AutoCal 2.2

U s e r   M a n u a l

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1 Introduction

2 Installation and Setup

3 The AutoCal Interface

4 AutoCal Automatic Display Setup

5 Troubleshooting

1 Introduction

1.1 Contents of Manual

Section 1 Introduction–(Current chapter) Outlines the document contents and conventions.

Section 2 Installation and Setup–This section describes the system characteristics required to run the AutoCal™ software, the installation requirements and how to properly set up the cameras and projectors.

Section 3 The AutoCal Interface–This section describes the options available in the software.

Section 4 AutoCal Automatic Display Setup–This section outlines how to use the software, including how to create and run AutoCal configuration files.

Section 5 Troubleshooting–This section lists some common issues and solutions that might be encountered during advance use of the software.

1.2 DOCUMENT CONVENTIONS

- KEYPAD COMMANDS/PC KEYSTROKES E.G., POWER, ENTER, CHANNEL
- *Content Reference e.g,. Section 5 - Troubleshooting*
- ***Document Reference e.g., Using 3D in Mirage***
- **Figure/Table References e.g., Figure 2.1, Table 4.3**
- **Software Menus/Options e.g., Show Warp, Control Point Properties**
- `Onscreen Messages e.g., No Signal`
- OPERATIONAL STATES E.G., POWER, ON, OFF

1.3 Related Documents

All of the information included in the User Manual is also included in the on-line help.

2   Installation and Setup

2.1   Recommended System Requirements

- PC with Intel or 100% compatible processor
- Windows XP SP3 or Windows 7
- 200 MB of free disk space 512 MB of RAM (1 GB recommended)
- Gigabit (Gbit) network connection
- Dedicated router with DHCP enabled

2.2   Projector Setup Requirements

AutoCal™ requires the following firmware versions to function correctly:

- Matrix StIM/SIM, Mirage WU-L, and Entero tested with projector firmware version 1.4.5 (1.0 minimum)
- M-Series tested with projector firmware version 1.7 (1.5.0 minimum)
- All other projectors tested with:
  - Projector firmware version: 1.6f (1.2f minimum)
  - Warping firmware version: 2.0
  - XPort firmware version: 3.5

NOTE: *Later versions of the firmware will likely work with no issue. Earlier versions should not be used.*

NOTE: *To check firmware versions, press MENU on keypad or remote. Select 6 STATUS to display version in the lower right corner of the Status window.*

NOTE: *.Twist files generated by AutoCal 2.2 require Twist 1.6.1 or later. To install the required version of Twist, navigate to D:\Twist\Setup.exe, substitute D: with the CD-ROM/DVD-ROM drive letter.*

2.2.1 Connecting the Projectors

1. Connect the PC to the network hub using an Ethernet cable or a wireless connection.

2. Connect an Ethernet cable from each projector to the network hub.

NOTES: 1) *The software will only run if at least one camera and one AutoCal enabled projector are connected.* **2)** *Each projector must have a unique projector ID.*
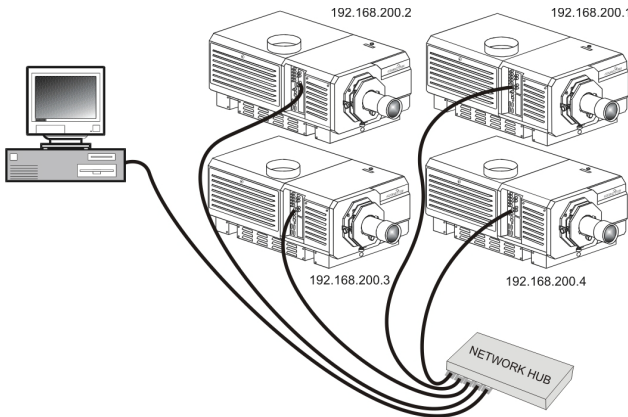
Figure 2-1 Ethernet Connection

2.2.2 Projector ID Configuration

If the software detects two projectors (connected serially) with the same ID, both projectors are flagged with an error status and no attempt to communicate is made.

1. Press MENU on the keypad or the remote.

2. Select 4 CONFIGURATION.

3. Select 7 COMMUNICATION.

4. Select 4 PROJECTOR ADDRESS

5. Specify a unique identification number.

6. Press the MENU button to exit.

2.2.3 Projector Network Configuration

1. Press MENU on the keypad or the remote.

2. Select 4 CONFIGURATION.

3. Select 7 COMMUNICATION.

4. Select 5 NETWORK ROUTING.

5. Select 1 SEPARATE.

   NOTE: *Alternative network routing options can cause time-outs and interfere with proper function of the software.*

6. Press the MENU button to exit.

2.2.4 Projector Port Number Configuration

When using an Ethernet connection, the port number set through the projector must match the port number set via the Communication Setup Wizard dialog box, which appears when searching for available projectors. For more information, see *4.5.1 Import Available Channels*.
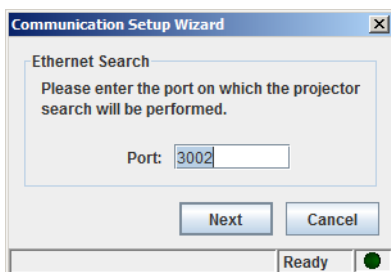
Figure 2-2 Communication Setup Wizard dialog box

1. Press MENU on the keypad or the remote.

2. Select 4 CONFIGURATION.

3. Select 7 COMMUNICATION.

4. Select 5 ETHERNET SETTINGS.

5. Ensure correct Port number is entered.

6. Press the MENU button to exit.

2.3 Camera Setup Requirements

2.3.1 Connecting the Cameras

The cameras are connected to the control PC via Ethernet connection, which includes one cable per camera, each connected to a network hub. Power to the camera(s) can be controlled automatically by connecting to a dual port network power switch. For more information, see *Section 3.1.3 Camera Settings Tab*.

Genie cameras are configured for DHCP network connection. Your network will automatically assign an IP address to the camera when it is plugged in.

To set up a static IP address on the camera, see *4.4.3 Change Camera IP*.

NOTES: 1) *The software will only run if at least one camera and an AutoCal enabled projector are connected.* **2)** *The cameras cannot be connected through a serial connection.*
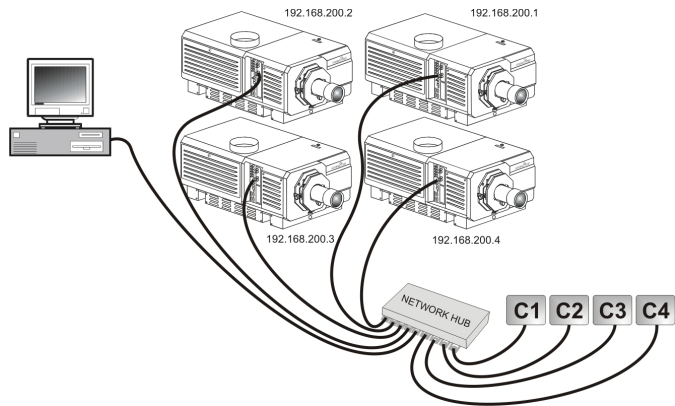
Figure 2-3 Camera Ethernet Connection

2.3.2 Dual Port Network Power Switch

Figure 2-4 Dual Port Network Power Switch

To automatically control power to the camera(s) they must be connected to a dual port network power switch. The control settings for this feature are located on the Camera Settings Tab. For more information, see *Section 3.1.3 Camera Settings Tab.*

NOTES: 1) *LEDs can also be connected to the dual port network power switch. For more information, see Section 3.1.5 Point Calibration Tab.* **2)** *Refer to the third-party Black Box Network Services Dual-Port Network Power Switch manual, for information on how to setup the IP address and subnet mask.*

Figure 2-6 illustrates an Ethernet connection via the dual port network power switch. This includes:

- 1 - Network hub
- 1 - Ethernet cable connecting the PC to the network hub
- 1 - Ethernet cable connecting the dual port network power switch to the network hub
- 4 - Cameras powered through a power bar, connected to a power port on the dual port network power switch
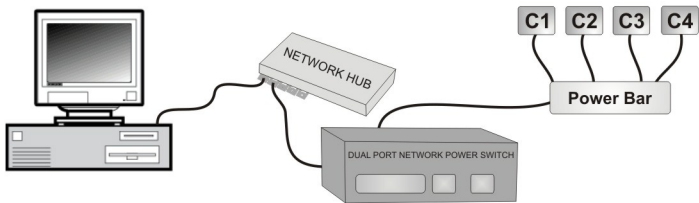
Figure 2-5 Ethernet Connection of the Dual Port Network Power Switch

2.4   Installing AutoCal Integration Tools

2.4.1 Uninstalling the Previous Versions

Before upgrading to AutoCal 2.2, uninstall the previous version of AutoCal and the supporting software:

- Christie AutoCal
- Dalsa Genie Framework
- Dalsa Sapera LT

1. Click **Start** and type **Add or Remove Programs** in the search bar.

2. Click **Add or Remove Programs** in the resulting list.

3. For each of the listed programs:

   a. Double-click the program you want to remove in the Add or Remove Programs dialog box.

   b. Click **OK** to confirm the uninstall.

2.4.2 Starting the Installation

NOTE: *During the installation process, you might be prompted to restart your machine. If so, select **No** and restart the machine after the full AutoCal installation process is complete.*

1. Insert the installation CD to start installing the first component.

   NOTE: *If the installation does not start automatically, click Start > Run. In the Run dialog type: D:\Setup.exe, substitute D: with the CD-ROM/ DVD-ROM drive letter.*

   The AutoCal installation wizard starts the following installations in order.

   • Genie Framework

   • Dalsa Sapera LT

   • AutoCal

NOTE: *The machine's network connection may be temporarily interrupted during this installation.*

2.4.3 Installing Genie Framework

If the CD version of Genie Framework is already installed, click Cancel to skip this procedure.

NOTE: *AutoCal requires the Genie Framework. If you are unsure whether the Genie Framework software is installed on your machine, install this software.*

1. At the Welcome window for the Genie Framework, click **Next**.

2. Read the License Agreement and then click **Yes** to proceed.

3. Click **Browse** if you want to change the default install folder and then click **Next** to begin installation.

4. Click **Next** at the Program Folder window.

5. Click **OK** on the popup that is displayed to indicate that the installation has completed.

NOTE: *If prompted to restart the machine, do so after fully completing the AutoCal installation process.*

2.4.4 Installing SaperaLT

If the CD version of SaperaLT is already installed, click **Cancel** to skip this procedure.

NOTE: *AutoCal requires the Genie SaperaLT. If you are unsure whether the SaperaLT software is installed on your machine, install this software.*

1. At the Welcome window for the SaperaLT, click **Next**.

2. Read the License Agreement and then click **Yes** to proceed.

3. Click **Browse** if you want to change the default install folder, then click **Next** to begin installation.

4. Install SaperaLT with CamExpert.

5. Click **Next** at the Program Folder window.

6. After installation is complete, select **No, I will restart my computer later** and then click **Finish** to continue (it could take up to a minute for the next window to appear).

NOTE: *If prompted to restart the machine, do so after fully completing the AutoCal installation process.*

2.4.5 Installing Autocal™ Software

1. At the Welcome window for AutoCal, click **Next**.

2. Fill in the **Full Name** and **Organization** fields.

3. Select from the user setting options, then click **Next**.

4. On the Destination Folder page, click **Next**.

5. Click **Next** once again to start the installation.

6. After installation is complete, click **Finish** to exit.

NOTE: *AutoCal automatically installs the following required software: Bonjour, Microsoft Visual C++ 2008 Redistributable, and Java Runtime Environment.*

2.4.6 Uninstalling AutoCal

You can uninstall AutoCal by re-running the installer and choosing the Remove option.

1. Insert the installation CD to start the installation wizard. The Welcome window displays Modify, Repair, and Remove options.

   NOTE: *If the installation does not start automatically, select Start > Run. In the Run dialog type: D:\AutoRun.exe, substitute D: with the specific CD-ROM/DVD-ROM drive letter.*

2. Select the **Remove** option, then click **Next**.

3. Click **Next** again to begin the uninstall process.

4. Click **Finish** to exit.

5. Once the software has been uninstalled, click **Finish** to close the installation wizard.

NOTE: *Genie Framework, SaperaLT, Bonjour, Microsoft Visual C++ 2008 Redistributable, and Java Runtime Environment may be used by other programs and are not uninstalled by the wizard. To uninstall these programs, see 2.4.1 Uninstalling the Previous Versions.*

2.5 AutoCal License Key

The AutoCal software must be activated with a Christie provided software license key. Activating the software with a registered license key enables geometric calibration (warping and blending). If you have also purchased Advanced Color Calibration, the registered license key also enables that functionality.

To view a list of features registered by the currently registered license key:

1. Click Help>View Licensed Features.

2.5.1 Request AutoCal License Key

1. Click **Help > Request License**.
2. Save the generated request file to a known location on your machine.
3. Contact Christie with the generated request file (request*.dat) to receive a valid license key.

NOTE: *ChristieLicenseRequest.exe is included on the installation CD. To generate a license key request file using the program directly, first copy the program to the local machine, then run the program. The generated file is located in the same directory as the program.*

2.5.2 Register AutoCal License Key

1. Click **Help > Register License Key**.
2. Browse to the license key file (*.key) provided by Christie and click **OK**.

![CHRISTIE]

3   The AutoCal Interface

AutoCal automatically creates and manages digital warps and blend definitions to stitch images from multiple projectors into a single seamless image. It has the capability to perform color and brightness matching, and can automatically calibrate almost any arrayed projection display solution to its optimal viewing configuration, regardless of size or shape from keystone corrections on flat screens, to spherical or cylindrical curved screens.
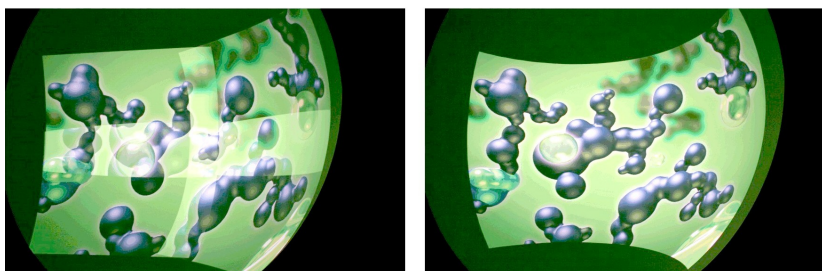
Figure 3-1 Before (L) and After (R) Calibration

3.1 Interface Overview

3.1.1 Configuration Wizard

Before initiating automatic calibration, you must define the parameters for the particular application. The interface consists of five tabs, which are used to set up and define the individual components and the relationships between the cameras, screens, and projectors.
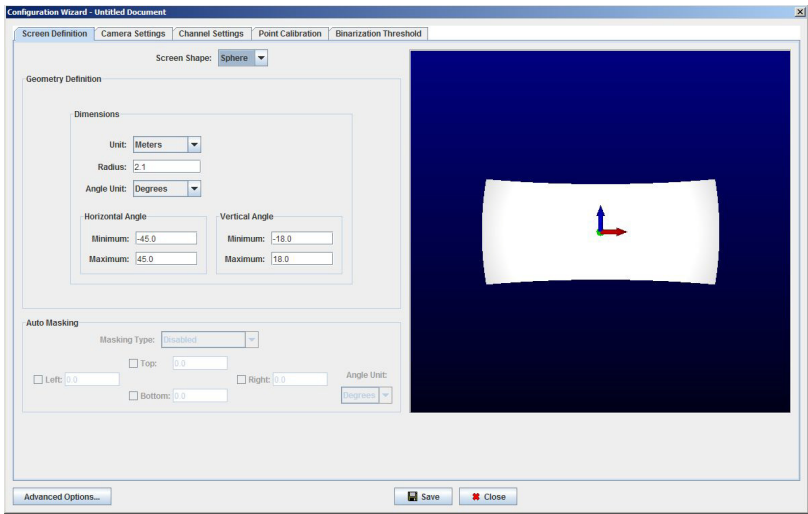
Figure 3-2 Configuration Wizard

3.1.2 Screen Definition Tab

The Screen Definition Tab (**Figure 3-3**) lets you define the physical characteristics of the screen. You can view a model of the screen from different perspectives in the Image Preview.

- To rotate the image, click the left mouse button and drag.
- To change the position of the image, click the right mouse button and drag.
- To zoom in/out, click the middle mouse button and drag (or use the UP/ DOWN arrow keys).
- To return to the default axis positions, press the X, Y, Z keyboard keys.

For details on how to set up the various screen definitions, see *4.3 Screen Definition Setup Procedures*.
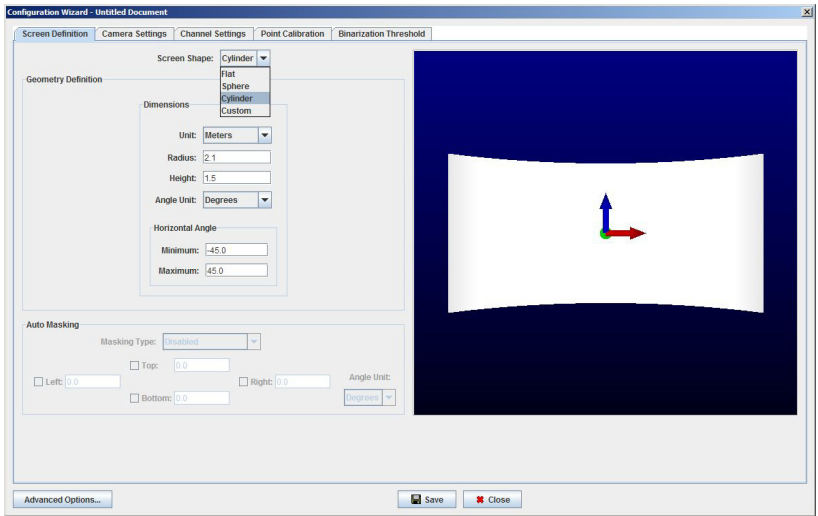
Figure 3-3 Screen Definition Tab

Screen Definition Features

Screen Shape: Select a screen shape from the list, or select Custom to import a new screen shape.

Geometry Definition: Use this feature to define the dimensions of the physical screen. The options change according to the selected screen shape.

For information about the options available for each screen shape, see *4.3 Screen Definition Setup Procedures*.

Auto Masking: Use this feature to fit an image to a specific screen shape without distorting the image geometry, by masking the extraneous information at the edge of the image. Auto masking is only available when shooting frustum-corrected data (i.e. spherical channel extents).

3.1.3 Camera Settings Tab

The Camera Settings Tab (Figure 3-4) is used to locate all available cameras and activate the cameras that you want to use with AutoCal. For specific camera setup information, see *4.4 Define Camera Settings*.
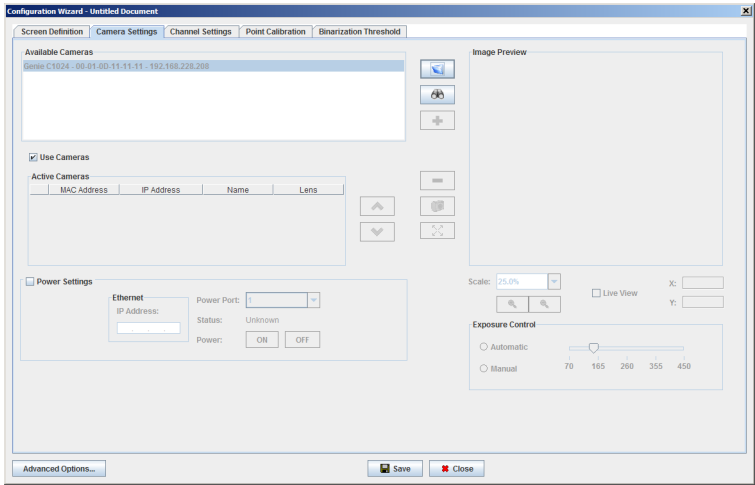
Figure 3-4 Camera Settings Tab

Camera Settings Features

Available Cameras: This section of the interface displays all the cameras that have been located on the network. Cameras that do not have intrinsic files registered or stored on the camera are grayed out and can not be added to the active camera list until the file is registered.

Open Intrinsic File Manager: Used to register/unregister intrinsic files for a camera (Figure 3-5). An intrinsic file contains intrinsic characteristics of the camera-lens combination, such as lens distortion, image center, and so on. The camera calibration process defines the extrinsic parameters of a camera, such as position and orientation. You must register an intrinsic file for the camera you wish to use (provided with the camera), before adding the camera to the active camera list. When a camera has intrinsic files registered for it, the registered lenses appear in the Lens dropdown field on the Active Cameras table. See Figure 3-5.

Figure 3-5 Intrinsic File Manager dialog box

Search for Available Cameras: When you click this button, AutoCal searches the network for all connected cameras. All cameras that are located appear in the **Available Cameras** list.

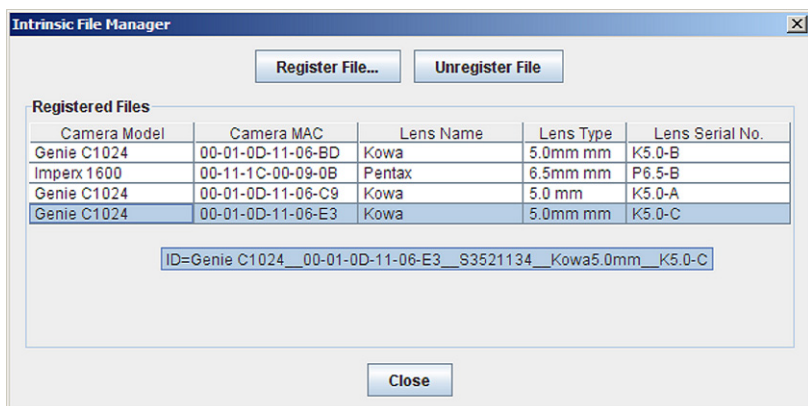**Add to Active List:** Select the camera in **Available Cameras** list that you want to add, and click this button to add it to the **Active Cameras** list. Repeat this step for each additional camera to be used by AutoCal. If no IP address is assigned to the camera a prompt appears requesting this information. The prompt already contains a valid IP address. You can accept the suggested IP address or enter a different address. Only a valid IP address will be accepted.

Use Cameras: When selected, AutoCal uses cameras during the calibration process. This is selected by default, and should normally be selected. Clear this check box only if you are using a setup without cameras; for instance, if you are using advanced color with no geometry correction.

Active Cameras: Once a camera is added, it appears in the **Active Cameras** list and a snapshot of the camera's image is shown in the image preview. To change the **IP Address** or **Name** fields, click on the field and enter the new information. See *4.4.3 Change Camera IP*.

The **MAC Address** cannot be changed. If available, the **Lens** field provides a drop-down list listing the lenses that were registered for this camera (through the Intrinsic File Manager). These selections enable the software to compensate for lens distortion when different lenses are used, such as a wide angle lens.

NOTE: *If there is an error, the following icon ⚠ appears beside the designated camera in the Active Cameras list. Ensure that the camera is connected and then click from the Camera Settings Tab to refresh the list. When the connection is found, the error icon disappears.*

Use the arrow buttons to move items in the **Active Cameras** list's order.

Remove from Active List: Click this button to remove a camera from the **Active Cameras** list.

Capture Image: Click this button to snap an image from the currently selected camera.

Expand Image: Click this button to open an expanded view of the image.

Image Preview: Anytime a camera is added or selected or an image is captured, this window displays an image from the specific camera.

Scale: Use this feature to change the scale of the image by manually entering a value or using the drop-down list.

Use these buttons to zoom in and out on the image. **NOTE:** *The mouse scroll wheel can also be used to zoom the image in/out.*

Live View: Activate this feature to view a live video feed from the camera. The live view option runs 2 to 3 frames per second.

X/Y: These fields display the current XY coordinates of the crosshair in the image preview.

Exposure Control: Select **Automatic** to have AutoCal calculate the exposure automatically. Select **Manual** and drag the slider to manually adjust the camera exposure rate (in µs). Each time the exposure changes, a new image is displayed in the image preview reflecting the change.

Power Settings

This section enables users to set up the connection to the dual port network power switch, which allows power to the camera(s) to be automatically controlled.

IP Address: Specify the IP address of the dual port network power switch.

NOTE: *AutoCal does not support serial connection to the power switch.*

Power Port: From this drop-down list select which power port on the dual port network power switch the cameras are connected to.

Status: This field displays the connection status to the dual port network power switch.

Power ON OFF **:** Use these buttons to turn power to the camera(s) ON and OFF.

3.1.4 Channel Settings Tab

The Channel Settings Tab (Figure 3-6) is used to locate all available projectors, as well as set up and define the projectors selected for the application. For details, see *4.5 Channel Setup Procedures*.
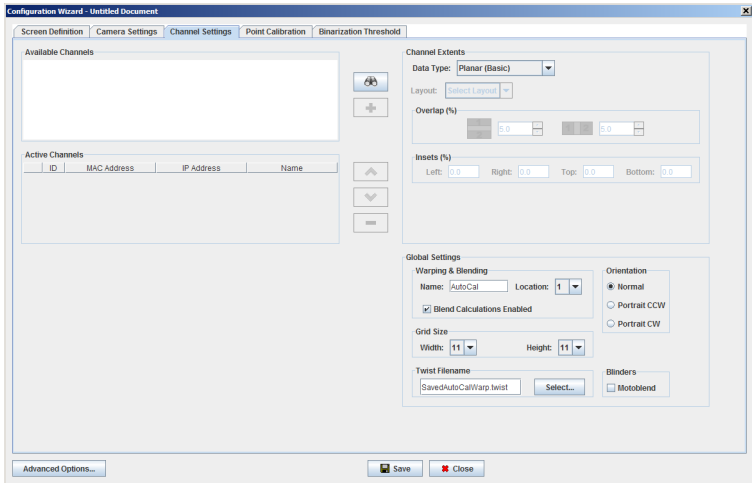
Figure 3-6 Channel Settings Tab

Channel Settings Features

Available Channels: This section of the interface displays the available channels.

Search for Available Channels: When you click this button, the Communication Setup Wizard dialog box appears. Specify the port to search for projectors. For more information, see *2.2.4 Projector Port Number Configuration*. Once the search is complete, all the located projectors are displayed in the **Available Channels** list.

Add to Active List: Once the specific projector from the **Available Channels** list has been selected, click this button to add the selected projector to the **Active Channels** list. Repeat this step for each additional projector to be added to the system.

Active Channels: Once a projector is added, it appears in the **Active Channels** list, as well as the **Channel Extents** list (for Advanced Planar, Spherical, and Collimated Spherical). To change the name, double-click on the **Name** field in the Active Channels table and enter the new name. The **MAC and IP address** cannot be changed.

NOTE: *If there is an error, the following icon* ⚠️ *appears beside the designated channel. Ensure that the projector is connected and then click* 🔍 *from the Channel Settings Tab to refresh the list. When the connection is found, the error icon disappears.*

⬆️⬇️ Use the arrow buttons to move items in the **Active Channels** list.

➖ **Remove from Active List:** Click this button to remove a channel from the **Active Channels** list.

Channel Extents: These settings define the dimensions of the projected content from each channel. For setup information, see *4.5.3 Define Channel Extents*.

Data Type: From this drop-down list, select one of **Planar (Basic)**, **Planar (Advanced)**, **Spherical**, or **Spherical (Collimated)** data. For more information, see *4.5.3 Define Channel Extents*.

Global Settings: This section is used to specify a name and a location for the warp and blend information saved to the projectors. For more information, see *4.5.4 Global Settings*.

Warping and Blending Name: Through this field the warp and blend name can be specified. The name defaults to `AutoCal`. To change the file name double-click in the designated field and enter the specific warp name. When a warp is saved to the projector it is added to the list of available warps. For more information, see *Saving Warps and Blends*. The naming convention is limited to 15 characters.

Location: This field identifies the memory location on the projector to which the warp settings can be saved. M-series projectors can store up to 16 custom warp definitions. All other projectors can store up to 10 custom warp definitions. For more information, see *Saving Warps and Blends*.

Blend Calculations Enabled: If left unchecked, blend calculations will not be done and no blending information will be sent to the projectors.

Grid Size: Use the drop-down lists to specify the number of points in the grid.

NOTE: *Twist Pro is required to read a .twist file with a grid size greater than 10.*

Twist Filename: Specify the output '.twist' file generated by AutoCal.

NOTE: *Twist 1.6.1 is required to open the .twist file generated by AutoCal 2.2.*

Orientation: When projector images are physically rotated, you can specify the orientation through this on-screen selection, which causes AutoCal to calibrate the image accordingly. Options are clockwise (CW), counter-clockwise (CCW), and none. Alternatively, you can set the roll component in the channel extents settings (see *4.5.3 Define Channel Extents*).

Blinders: Indicates if Moto Blend is being used in the setup.

3.1.5 Point Calibration Tab

Once the physical characteristics of the screen are defined, the camera can be calibrated (**Figure 3-7**). Defining the screen coordinates is essential to accurately performing automatic projector calibration. Using this tab, you can define a series of calibration points. These are points whose locations are accurately known in real-world coordinates (X,Y, Z). The system uses these points to calibrate both the position and orientation of the camera. For more information, see *4.6 Point Calibration Setup Procedures*.
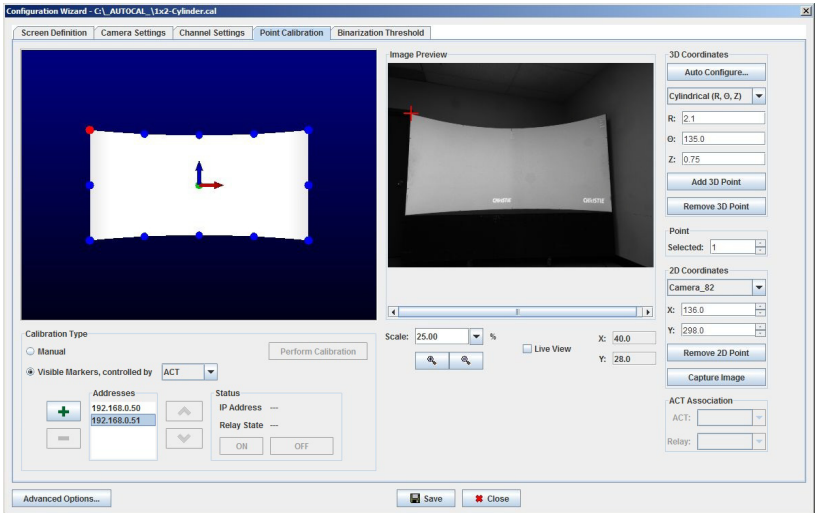
Figure 3-7 Point Calibration Tab

Point Calibration Features

Preview Windows

3D Preview Window: This window displays a 3D model of the screen, as defined via the Screen Definition Tab and displays the markers once they are defined.

Image Preview: This window displays the image from the active camera.

Scale: Use this feature to change the scale of the image by manually entering a value or using the drop-down list.

![zoom buttons] Use these buttons to zoom in and out on the image.

Live View: Stream the output from the camera selected in the 2D Co-ordinates panel.

X/Y: These fields display the current XY coordinates of the crosshair in the image preview.

Calibration Type:

- **Manual:** Select this option to perform the calibration manually with no visible markers on the projection screen.

- **Visible Markers:** Select this option to calibrate using visible markers. Specify how the visible markers will be turned on and off with the **controlled by** drop-down list.

  Checking this option indicates that the points displayed in the 3D preview window represent visible markers such as screen LED markers that can be detected by the system. It is still necessary to specify which 3D points are seen by each camera. This is done by selecting a 2D image location for each 3D point that a camera sees. The location of the 2D image points are not important; the selection is used as a mechanism for telling the system which 3D points are seen by which camera (since each camera may only see a subset of all of the 3D calibration points).

  When **Visible Markers** option is selected, the **Markers** drop-down list on the Binarization Threshold Tab includes the choice to select **Cameras**. This enables users to specify the binarization and camera exposure settings for the cameras and grid separately. This is essential since the binarization thresholds and camera exposure settings may not be the same for camera marker detection and projector grid detection.

  In the **controlled by** drop-down list, select how the visible markers are turned on and off from one of these options:

  • **BlackBox:** This indicates that a Black Box dual port network power switch will control the connected camera visible markers. Specify the **IP Address** of the switch, the **Power Port** on the switch that the LEDs are connected to, and use the **Power** buttons (ON/OFF) to turn the power to the marker(s) on and off.

  • **User:** This indicates that a user will manually turn the visible markers on and off when prompted by AutoCal. This mode is meant to be used only within the configuration wizard. After that, manual calibration must be selected to use the new 2D values.

  • **ACT:** This indicates that an ACT device will control the connected camera visible markers. Use the Add and Delete buttons to add and delete device addresses. Use the up and down arrow buttons to change the order of the device addresses. Use the ON and OFF buttons to turn the markers for the specified device on and off.

ACT Association:

- **ACT:** From the drop-down list, select which ACT device to associate a relay with.

- **Relay:** From the drop-down list, select which relay to associate to the selected ACT device.

3D Coordinates: Use this field to define the 3D coordinates of the points in the 3D preview window. Anytime a point is activated the coordinates for that point are displayed in the **XYZ** fields. To alter a point's position; select the point, type in a new coordinate and press ENTER.

- **Cartesian:** A coordinate system that defines positions based on their projection onto a series of perpendicular axes. Three coordinates (X, Y, Z) represent the position along the perpendicular X, Y, Z axes.

- **Cylindrical**: A system of coordinates in which the position of a point in space is determined by its distance from the Z-axis (R), its distance from the XY-plane (Z), and its angular distance from the X-axis (Φ) when projected onto the XY-plane.

- **Spherical**: A system of coordinates in which the position of a point in space is designated by its distance from the origin (R), the angle between the positive Z-axis and the line formed between the origin and point (Θ), and the angle between the positive X-axis and the line from the origin to the point projected onto the XY-plane (Φ).
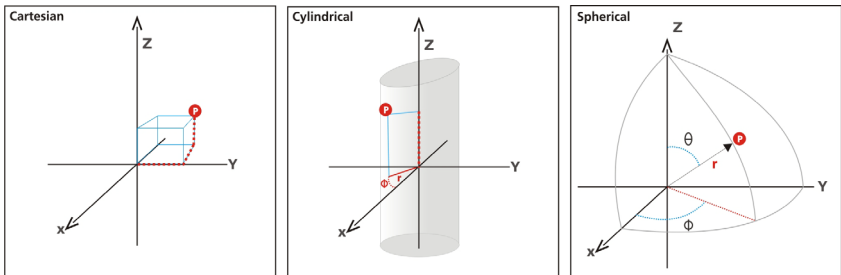

Figure 3-8 3D Coordinates

2D Coordinates: Through this field the 2D coordinates of the points are defined. For more information, see *4.6.1 Define Points*.

Point/Selected: Identifies the selected point.

`Add Point` Adds a point to the center of the model in the 3D preview window (0,0).

NOTE: *When inserting multiple points ensure the position of each point is altered so it is not in the center of the image. This allows you to easily identify the next added point.*

`Remove Point` Click this button to delete the selected point in the 3D preview window.

`Auto Configure...` Click this button to open the Auto Configure dialog box.
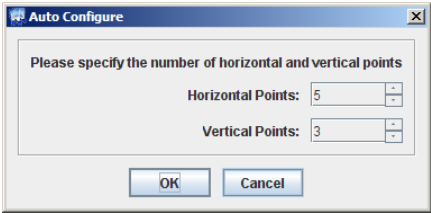
Figure 3-9 Auto Configure Dialog Box

Use this dialog box to define the number of 3D points to use as reference for camera calibration. The number of horizontal and vertical points are automatically generated according to the screen definition. Click OK to create the points. The points are evenly distributed across the screen surface. Afterwards, you can add, move, or remove points.

Capture Image Click this button to snap an image from the currently selected camera.

Test Calibration... Click this button to test the location of the 3D and 2D points. The goal is to achieve a low calibration tolerance. See section *4.6.5 Perform Camera Calibration* for details.

Advanced Zoom: Press the CTRL key when the mouse is in the Image Preview window to display a pop-up dialog box containing a zoomed section of the image. This allows points to be quickly selected at greater accuracy.
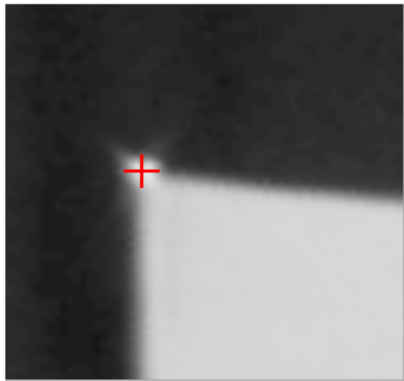

Figure 3-10 Point Calibration-Advanced Zoom

3.1.6 Binarization Threshold Tab

The Binarization Threshold Tab (Figure 3-11) is used in conjunction with geometry correction. It lets users define the threshold of the black (dark) and white (bright) pixels of the captured image.

To change the binarization threshold and camera exposure, at least 1 projector and 1 camera must be connected and activated.

Once a camera is activated from the Camera Settings Tab, users are able to adjust the binarization threshold and camera exposure of the selected camera.

NOTE: *AutoCal can automatically determine exposure and binarization threshold settings in most cases. To have AutoCal do this, select **Automatic** under Camera Control on this tab.*

When a binarized image is taken, the projector(s) in the system displays a black background with a white grid. If 'Camera Markers' are selected, the camera visible markers (i.e., screen LED) are turned ON to select correct binarization and exposure values to detecting these markers.The ideal outcome is to diminish image background noise and to have all grid points fully captured. For more information, see *4.7 Binarization Threshold Setup Procedures*.
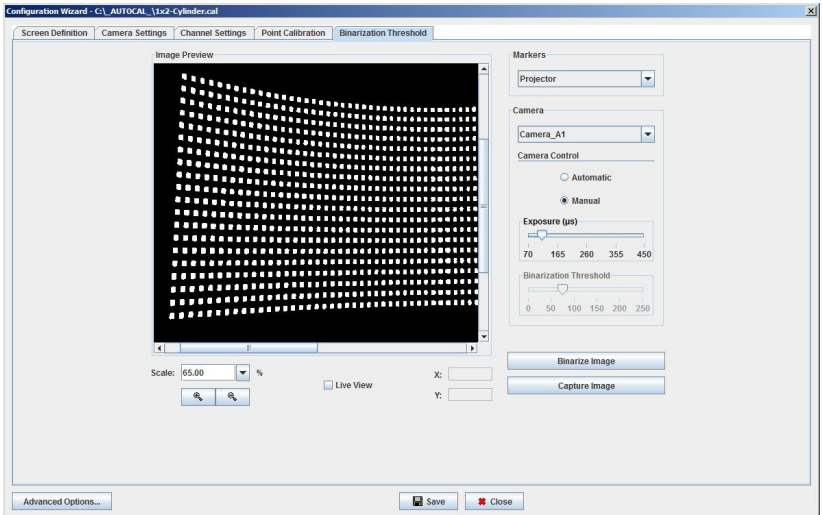

Figure 3-11 Binarization Threshold Tab

Binarization Threshold Features

Image Preview: The image preview displays the image of the selected camera.

- **Scale:** Enter a scale value or select a scale value from the drop-down list. Image scale can also be adjusted using the mouse wheel.
- 🔍 🔍 Click these buttons to zoom in and out on the image.

- **Live View:** Select this check box to show a live view of what the camera is seeing.
- **X/Y:** These fields display the current XY coordinates of the crosshair in the image preview.

Markers: From the drop-down list, select whether to set binarization and exposure levels using the **Projector** or the **Camera**. Projector binarization/exposure levels are used during the display calibration process when test patterns are being projected onto the screen. Camera binarization/exposure levels are used while automatically calibrating the cameras.

Camera: From the drop-down list, select a specific camera. When multiple cameras are incorporated, users must set up binarization and exposure values for each one.

NOTE: *The camera markers option is available only when the **Visible Markers** option is selected on the Point Calibration tab*.

This feature enables users to define separate binarization threshold and camera exposure settings for capturing grid points and camera visible markers.

- **Camera Control:** Select whether you want **Automatic** or **Manual** control over the camera. AutoCal can automatically determine exposure and binarization threshold settings in most cases, so you should select Automatic. If you select Manual, then the following controls are available:

  • **Exposure:** Drag the handle to set the amount of time (micro-seconds) the camera shutter remains open while capturing images.

  • **Binarization Threshold:** Drag the handle to adjust binarization threshold. This value determines how bright an image pixel must be before it appears in the binarized image (i.e. before it flips to white).

- **Binarize Image:** Click this button to display the image binarized. When you click, the selected markers are turned on. If you selected projector markers, all active projectors in the system display a grid test pattern. If you selected camera markers, the LED markers are turned ON.

- **Capture Image**: Click to captures an image from the currently selected camera.

3.1.7 Advanced Options

Advanced configuration options let you change some settings directly when setting up irregular arrays or when troubleshooting.

Caution: *These options require an advanced understanding of the software. Do not attempt to change these settings if you do not understand their interaction with the generated data.*
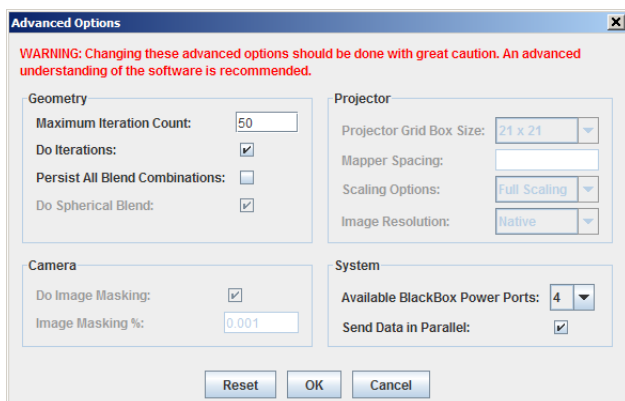
Geometry

Maximum Iteration Count: Indicates the maximum number of iterations used to converge points to their targets. Specify a value between 5 and 100. The default value is 50. A typical calibration can take between 20 and 30 iterations. A low value speeds up the calibration but can produce a suboptimal result.

Do Iterations: The Mapper uses the available information to calculate initial targets. Select this option to fine tune the calibration. Clear this option to use the initial calculations. This option is available only when you choose Mapper in the Extrapolation Engine dropdown list.

Persist All Blend Combinations: Indicates whether or not all possible blend combinations are to be saved to the projector.

Select this option to store each edge blend in its own blend memory location. See Figure 3-13.

Clear this option to calculate and store all edge blends in a single blend memory location (default). See Figure 3-12.

Figure 3-12 Default blends for 1×3 projector array

Figure 3-13 Alternative arrangements for 1×3 projector array

Table 3.1 Possible blend combinations for a 1×3 projector array

Array	Blend Regions	Stored Blends Per Projector		
		Proj 1	**Proj 2**	**Proj 3**
A - 1×3	2	Right	Left, Right	Left
B - 1×2, 1	1	Right	Left	None
C - 1, 1×2	1	None	Right	Left

Do Spherical Blend: When dealing with spherical content, AutoCal performs spherical blending by default when this option is selected. If spherical blending is not producing the results that you want, you can clear this check box to use edge-based blending instead. This option is only available when spherical content is selected.

Projector

Projector Grid Box Size (Width/Height): Size in projector pixels of grid points drawn during calibration. The default is 21×21 pixels. The camera's ability to distinguish the points is affected by the size of the points, the ambient light, and the distance between the camera and the projected image.

Mapper Spacing: Identifies the spacing (multiplier) between grid points used to by the Mapper extrapolation engine.

Scaling Options: From this drop-down list, select whether you want to display content at full screen (Full Scaling) or the resolution specified by Image Resolution.

Image Resolution: Specify the resolution at which you want to display content. This setting is not available if Full Scaling is selected in the Scaling Options drop-down list.

Camera

Do Image Masking: Check this option to use image masking.

Image Masking %: Indicates how much to increase the mask shape relative to the screen size in the camera's image. If 0.0 sets the mask to the size of the screen, then a value of 0.1 would set the size at 10% greater than the size of the screen.

System

Available BlackBox Power Ports: Indicates the number of power ports available on the BlackBox. Refer to the hardware.

Send Data in Parallel: Select this option to send warps, blends, and masks to all projectors at the same time. Clear this option to send warps, blends, and masks to one projector at a time.

4 AutoCal Automatic Display Setup

4.1 Shortcut Keys for 3D Screen Preview

Table 4.1 Shortcut Keys for 3D Screen Preview

KEY CONTROL	COMMAND
X	Reset the viewpoint to centre on the X-axis.
Y	Reset the viewpoint to centre on the Y-axis.
Z	Reset the viewpoint to centre on the Z-axis.
UP Arrow	Zoom the viewpoint forward.
DOWN Arrow	Zoom the viewpoint backward.

NOTE: *Press F1 to access the on-line help from any tab.*

4.2 File Configuration

AutoCal works with configuration files which contain camera settings, projector settings, screen definitions, and camera calibration points.

When you start the software, you can create a new configuration file or open an existing one.
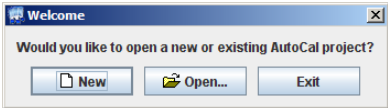
Figure 4-1 Welcome Dialog Box

4.2.1 Create a New File

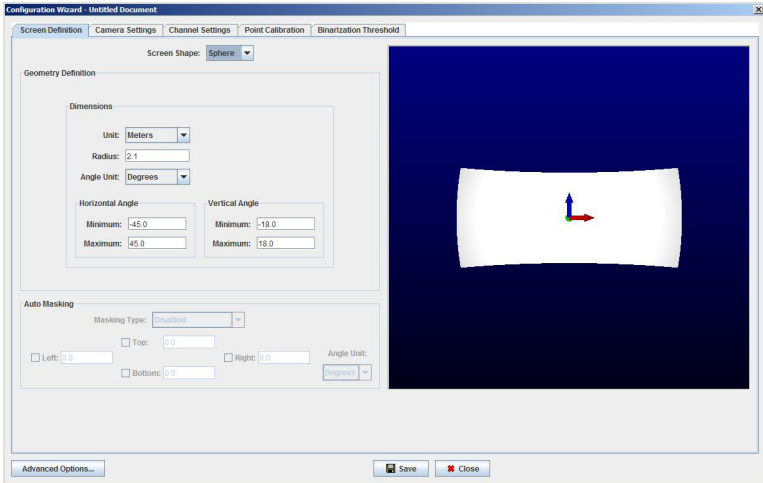1. Click [New] to open the Configuration Wizard with default settings.

Figure 4-2 Configuration Wizard - Untitled Document

2. Change the settings on each tab for your display.

3. Click [🖫 Save] to save the configuration file.

4.2.2 Load an Existing File

1. Click [🗁 Open...].

2. Browse to the folder where your configuration files are stored.

3. Select the .cal file and click [Open].

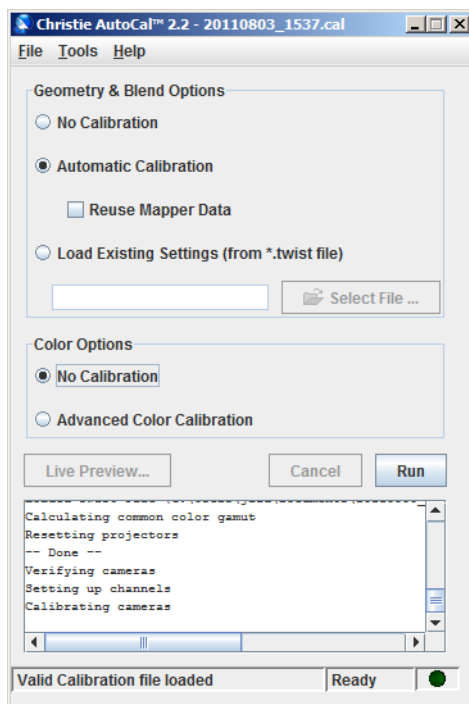   The AutoCal window displays device information and status.

Figure 4-3 Christie AutoCal Main Window

4. To run the current file click ![Run] . For more information, see *4.9 Run Auto-Calibration*.

5. To edit the current file, click **File** > **Edit**.

6. To save the current file to a different filename, click **File** > **Save As**.

4.3   Screen Definition Setup Procedures

This section outlines procedures for setting up the geometry definitions that define the characteristics of the physical projection screen.

Do the following to change the size, position, and orientation of the screen representation in the preview window:

*   To rotate the image, click the left mouse button and drag.

*   To change the position of the image, click the right mouse button and drag.

- To zoom in/out, click the middle mouse button and drag (or use the UP/DOWN arrow keys).

- To return to the default position, press the X, Y, Z keyboard keys.

4.3.1 Flat Screen Geometry

1. Select **Flat** from the **Screen Shape** drop-down list.

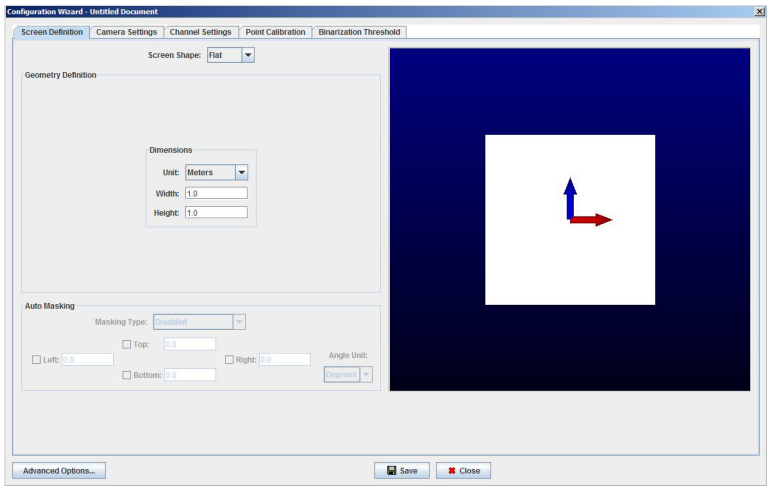   The preview window displays a graphical representation of the screen.

Figure 4-4 Screen Definition Tab - Flat Screen Geometry

2. Select the unit of measure from the **Unit** drop-down list.

3. Specify the **Width** and **Height**. The preview window automatically updates when the dimensions are changed.

4.3.2 Spherical Screen Geometry

1. Select **Sphere** from the **Screen Shape** drop-down list.

   The preview window displays a graphical representation of the screen.
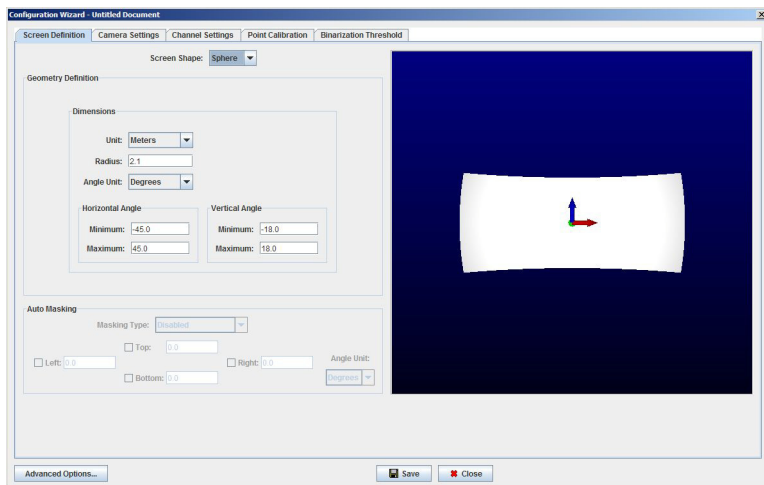

Figure 4-5 Screen Definition Tab - Spherical Screen Geometry

2. Select the unit of measure from the **Unit** drop-down list.

3. Specify the **Radius** of the screen.

4. Define the minimum and maximum horizontal angle of the screen in degrees.

   • The minimum horizontal angle is measured from the center of the screen to the left side.

   • The maximum horizontal angle is measured from the center of the screen to the right side.

5. Define the minimum and maximum vertical angle of the screen in degrees.

   • The minimum vertical angle is measured from the center of the screen to the bottom.

   • The maximum vertical angle is measured from the center of the screen to the top.

4.3.3 Cylindrical Screen Geometry

1. Select **Cylinder** from the **Screen Shape** drop-down list.

    The preview window displays a graphical representation of the screen (**Figure 4-6**).
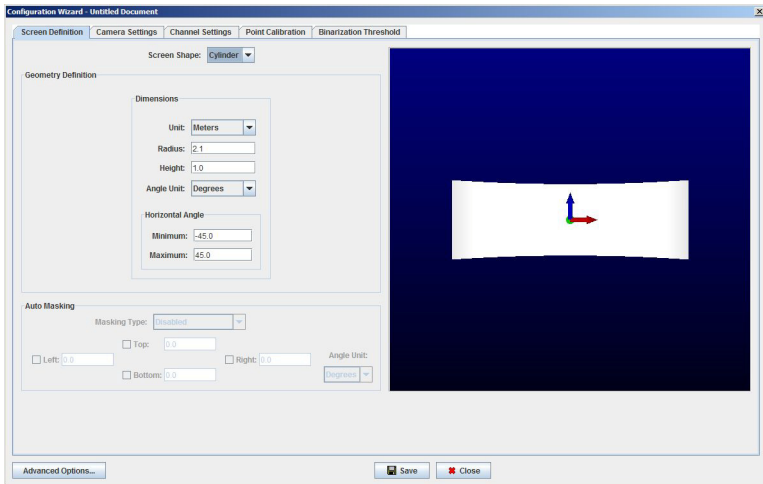

Figure 4-6 Screen Definition Tab - Cylindrical Screen Geometry

2. Select the **Unit** of measurement. The available units of measurement are; **millimeters**, **centimeters**, **inches**, **feet** and **meters** (default).

3. Specify the **Radius** of the screen.

4. Specify the **Height** of the screen.

5. Define the minimum and maximum horizontal angle of the screen.

    •   The minimum horizontal angle is measured from the center of the screen to the left side.

    •   The maximum horizontal angle is measured from the center of the screen to the right side.

4.3.4 Custom Screen Geometry

The Custom option lets the system work with user-specified screen shapes. It requires a valid .wrl file (vrml97) produced in photogrammetry or CAD software. This option requires frustum corrected data, i.e., spherical channel extents.

1. Select **Custom** from the **Screen Shape** drop-down list.

2. Click the file button to open the file browser.

3. Navigate to the .wrl file and click **OK** to load the file.

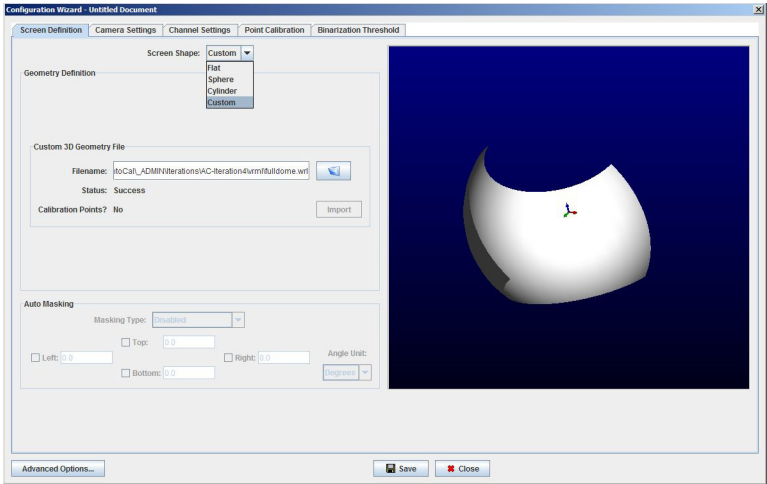   The preview window displays a graphical representation of the screen (**Figure 4-7**).

Figure 4-7 Screen Definition Tab - Custom Screen Geometry

NOTE: *A Status of Invalid File indicates that the .wrl file is invalid or missing.*

4. If the .wrl file includes calibration points, click the **Import** button.

    NOTE: *If **Calibration Points** displays NO, the .wrl file does not include calibration points and the Import button is not available. Enter the calibration points manually. See* <u>Add Points Manually on page 4-22</u>*.*

4.3.5 Auto Masking

Auto Masking is only available when shooting frustum corrected data for example spherical channel extents.

1. To enable auto masking, click the Channel Settings tab and select **Spherical** from the **Data Type** drop-down list in the Channel Extents panel.
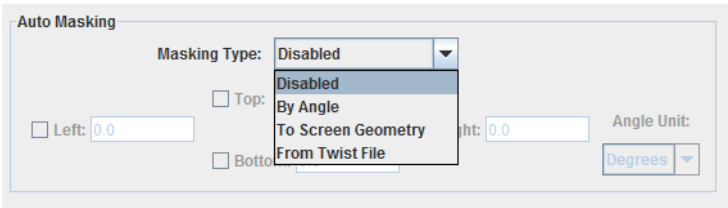
2. Click the Screen Definition tab.

Figure 4-8 Auto Masking

3. Under Auto Masking, select the **Masking Type** to use from the drop-down list:

   • **Disabled**: no masking

   • **By Angle**: masking is specified by absolute angular values. Check the edge(s) of the projected image to mask (for example, Top and Left) and specify the masking area in degrees.

   • **To Screen Geometry**: masking is applied to the shape of the screen geometry.

   • **From Twist File**: masking settings are set by the Twist file specified under Global Settings on the Channel Settings tab. Using this setting, you could customize masking settings in TWIST and then use these settings in AutoCal.

   The masking guidelines simulate the shape that is applied to the projected image. All 4 screen masking areas do not need to be selected and the values do not have to be symmetrical.

4.4 Define Camera Settings

4.4.1 Import Available Cameras

The Camera Settings tab lets you specify the cameras to be used in the application. It also lets you check each active camera's image.

1. Click [🔍] to search for all available cameras.

   The software detects cameras that are properly connected and displays them in the **Available Cameras** list (**Figure 4-9**).

   NOTE: *If additional cameras are added to the network, click* [🔍] *at anytime to update the list.*

2. Click to select a camera from the **Available Cameras** list.

Figure 4-9 Camera Settings Tab - Available Cameras List

NOTE: *Cameras listed in black have a registered intrinsics file that identifies information about the camera including the lens. For information about registering a camera, see Camera Settings Features on page 3-4.*

3. Click ![plus] to add the selected camera to the **Active Cameras** list.

The selected camera is added to the **Active Cameras** list. A snapshot from the camera is displayed in the image preview and the controls for the preview are activated. Only one camera can be added at a time.
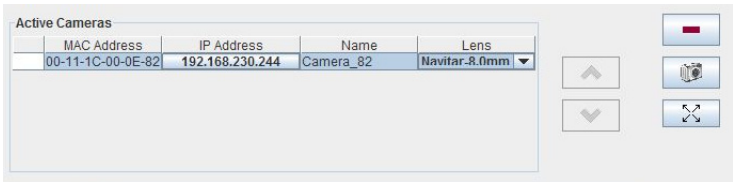
Figure 4-10 Camera Settings Tab - Active Cameras List

NOTES: 1. *To manually change the camera name double-click on the Name field until the cursor key appears and type in the new information.* **2.** *To manually change the IP address click on the IP Address field, the Change Camera IP Address dialog box appears.* **3.** *The MAC Address cannot be changed.* **4.** *Most cameras have an IP address assigned automatically. For cameras that do not have an IP address, the software prompts you to enter a valid IP address. Accept the prompted values or change the IP address, and click OK. Only a valid IP address will be accepted.*

Figure 4-11 Change Camera IP Address Dialog Box

4. If known, select the correct lens type for the particular camera from the **Lens** drop-down list.

5. Use the arrow keys beside the **Active Cameras** list to reorganize the list.

NOTE: *When a camera connection is lost, the following icon* ⚠ *appears beside the specific camera. Position the mouse over the icon to view the status of the error. Check to ensure the camera is connected and then click* 🔍 *to refresh the list. When the connection is found, the error icon disappears.*

Remove Cameras

1. Click to select the camera in the **Active Cameras** list.

2. Click ➖ to remove the selected active camera from the **Active Cameras** list. **NOTE:** *Only one camera can be removed at a time.*

Capture an Image

1. To capture an image select the camera in the **Active Cameras** list.

2. Click 📷 to view an updated image in the image preview.

    NOTES: 1) *To view a live feed from the camera, click the Live View option. This runs two to three frames per second.* **2)** *Click* ✕ *for an expanded view of the image. Press ESC or close the window to return to the Configuration Wizard.*

Manipulate an Image

1. To change image scale, either enter a value in the **Scale** field, select a predefined value from the drop-down list or use the **Zoom In** and **Zoom Out** buttons. Image scale can also be adjusted using the mouse wheel.

2. To increase or decrease image exposure, drag the slider to adjust the camera exposure. Each time a slider is adjusted, a new image is captured and displayed in the image preview window.

NOTE: *If camera alignment, brightness, or focus are not correct, manual camera adjustments may be required (i.e., move camera to center image on desired location, adjust aperture ring on lens, adjust focus ring on lens.). Recapture and repeat until satisfactory results are achieved.*

4.4.2 Define Power Settings

To automatically control power to the camera(s), it must be connected to a dual port network power switch. The control settings for this feature are located on the Camera Settings Tab, as shown in **Figure 4-12**.
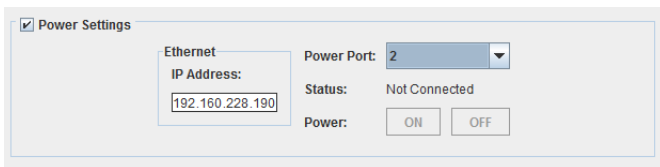
Figure 4-12 Camera Settings Tab - Power Settings

Ethernet Setting

1. Check **Power Settings** to activate the option.

2. Specify the IP address assigned to the dual port network power switch.

3. Select the **Power Port** that the camera is connected to on the dual port network power switch. The port must be correctly identified to control the camera's power.

4. Use the **Power ON/OFF** buttons to control power to the camera(s).

   NOTE: *If multiple cameras are used, they should all be powered through the same power port on the dual port network power switch (i.e. via a power bar).*

4.4.3 Change Camera IP

1. To change the network configuration of the camera, click on the IP Address field for the camera in the Active Cameras table. The Change Camera IP Address dialog box appears.

Figure 4-13 Change Camera IP Address Dialog Box

The camera can be set up in either **DHCP** mode or **Static IP** mode. If set to DHCP, the camera will receive an IP address as given by the network configuration that the camera is currently connected to. If set to Static IP, the user has full control over changing the network configuration of the camera.

NOTE: *An incorrect IP address assignment can make it impossible to connect to the camera. If the network settings of the camera are changed such that they differ from your current machine's network settings, the machine may no longer be able to detect the camera on the network. If you have lost communication with the camera, see 5.2 Unable to Connect to Camera within the troubleshooting guide.*

4.5 Channel Setup Procedures

The Channel Settings Tab is used to:

- Select the projectors to be used for the application.
- Set layout options for the projectors and data.

Before adding a projector have the following information:

- the projector's ID
- the projector's IP address and port.

NOTE: *To find the IP and port, press Menu from the projector keypad or remote. Select 4 Configuration, 7 Communications and 5 Ethernet Settings.*

4.5.1 Import Available Channels

1. On the Channel Settings Tab, click [⚷] to search for all available projectors. The Communication Setup Wizard dialog box (Figure 4-14) appears, prompting users to specify which how the projectors are connected.
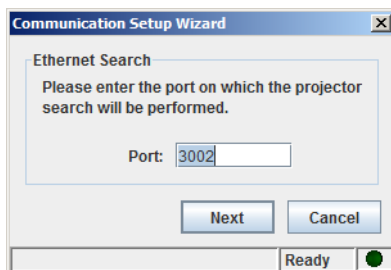

Figure 4-14 Communication Setup Wizard Dialog Box

2. Specify the **Port** number on which you want AutoCal to search for projectors.

NOTE: *Ensure the port number matches the port number set on the projectors. For more information, see 2.2.4 Projector Port Number Configuration.*

3. Click ☐ Next ☐ to begin the search.

   The software detects the projectors that are properly connected and displays them in the **Available Channels** list (**Figure 4-15**).

   NOTE: 1) *Click ☐ 👀 ☐ at anytime to update the list.*

4. Click to highlight a projector in the **Available Channels** list and click ☐ ➕ ☐ to add the projector to the **Active Channels** list. Only 1 projector can be added at a time.
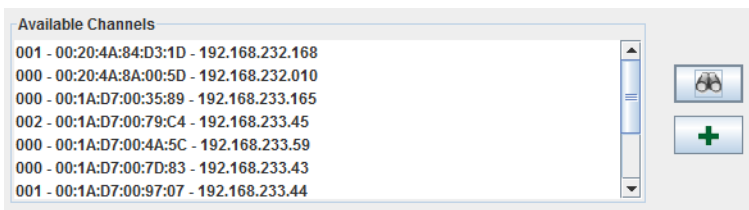
```
Available Channels
001 - 00:20:4A:84:D3:1D - 192.168.232.168          ┌──────┐
000 - 00:20:4A:8A:00:5D - 192.168.232.010          │  👀  │
000 - 00:1A:D7:00:35:89 - 192.168.233.165          └──────┘
002 - 00:1A:D7:00:79:C4 - 192.168.233.45           ┌──────┐
000 - 00:1A:D7:00:4A:5C - 192.168.233.59           │  ➕  │
000 - 00:1A:D7:00:7D:83 - 192.168.233.43           └──────┘
001 - 00:1A:D7:00:97:07 - 192.168.233.44
```

Figure 4-15 Channel Settings Tab - Available Channels

NOTES: 1) *To manually change the Name, double-click in the field until the cursor key appears and type the new information.* **2)** *The MAC Address cannot be changed.* **3)** *The IP Address can not be changed from the AutoCal software.* **4)** *An error icon ⚠ beside a projector indicates that the connection with the projector was lost. Position the cursor over the icon to view the status of the error. Check to ensure the projector is connected and then click ☐ 👀 ☐ to refresh the list. When the connection is found, the error icon disappears.*

5. Use the arrow buttons beside the **Active Channels** list to reorganize the list.

4.5.2 Remove Channels

1. Select the projector from the **Active Channels** list.

2. Click ☐ ➖ ☐ to return the selected projector to the Available Channels list.

4.5.3 Define Channel Extents

This section outlines how to setup the projected area of a particular channel. The projected area is the section on the screen in which each projector projects its image. There are three different ways in AutoCal to define the channel extents for a system:

- **Planar (Basic)**—Select this option when displaying a view with a single viewport, such as a multi-headed windows desktop. The vertical and horizontal overlaps of each channel must be defined. See *Projecting Planar Data (Basic) on page 4-14*.

- **Planar (Advanced)**—Select this option when displaying a view with a single viewport, but where you want to control the section of the screen that each channel covers. See *Projecting Planar Data (Advanced) on page 4-15*.

- **Spherical**—Select this option when displaying frustum corrected data. The Heading and Field of View angles of each channel must be defined. See *Projecting Spherical Data on page 4-16* and *Projecting Collimated Spherical Data on page 4-18*.

Projecting Planar Data (Basic)

Select Planar Data when displaying a view with a single viewport, such as a multi-headed windows desktop. Channel layouts are defined by the overlaps between adjacent channels. The projected area of all channels will fill the entire screen.

1. Ensure all required cameras and channels are active. Refer to *4.4.1 Import Available Cameras, on page 4-8* and *4.5.1 Import Available Channels, on page 4-12*.

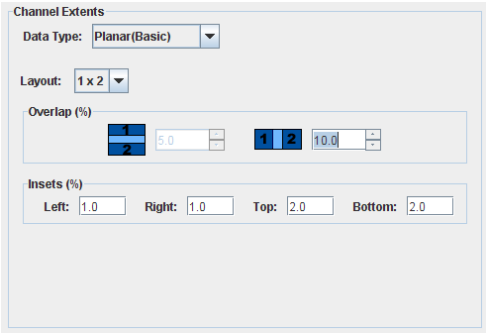2. Select **Planar (Basic)** from the **Data Type** drop-down list

Figure 4-16 Planar–Basic

NOTE*: Twist 1.6.1 is required to open the .twist file generated by AutoCal 2.2.*

3. Define the configuration from the **Layout** drop-down. See *Define the Layout, on page 4-15*.

4. Depending on the Layout selected, enter the horizontal and/or vertical overlap percentages (percentage in channel pixel space).

5. To further inset the projected image inward, specify insert percentage values (percentage in screen space). A positive inset value will create a black border around the final full image.

Define the Layout

NOTE: *The layout only needs to be specified if Planar (Basic) mode is selected.*

The layout of channels changes to reflect the various options associated with the number of projectors selected for the particular configuration.

For example, when two projectors are active, the **Layout** drop-down list contains the selections **1x2** and **2x1**. When four projectors are selected, the list include: **1x4**, **2x2**, **4x1**. Users must define the layout configuration of the application before continuing.

Projecting Planar Data (Advanced)

Select Planar Data (Advanced) when displaying a view with a single viewport, but when you want to control the area covered by each projector. The projected area of all channels can exceed the screen area resulting in loss of some pixels off the screen.

1. Ensure that all required cameras and channels are active. Refer to *4.4.1 Import Available Cameras* and *4.5.1 Import Available Channels*.

2. Select **Planar (Advanced)** from the **Data Type** drop-down list.

Figure 4-17 Planar - Advanced

3. Define the configuration from the **Layout** drop-down. Refer to *Define the Layout, on page 4-14.*

4. Enter the channel extents for each channel (specified in screen relative percentages). For example, setting up a 1x2 might have the following advanced planar information:

    • both channels have a starting Y of 0%, ending Y of 100%

    • channel (1,1) has a starting X of 0%, ending X of 55%

    • channel (1,2) has a starting X of 45%, ending X of 100%

Y:	
0%	Top edge of screen
100%	Bottom edge of screen
X:	
0%	Left edge of screen
100%	Right edge of screen

NOTE: *A setup which has a screen-relative overlap of 10%, is NOT the same as a 10% channel-relative overlap – as would be specified in Planar (Basic) mode.*

Percentages below 0% and above 100% are valid, and will result in projector pixels being lost outside the defined screen.

Projecting Spherical Data

When shooting spherical data onto a spherical screen, a warp is required to project the content accurately. When **Spherical** is selected, the overlaps for each channel must be specified. This is done by defining the angular extents of each channel (by Heading and Field of View). A non-zero **Eyepoint** may also be specified.
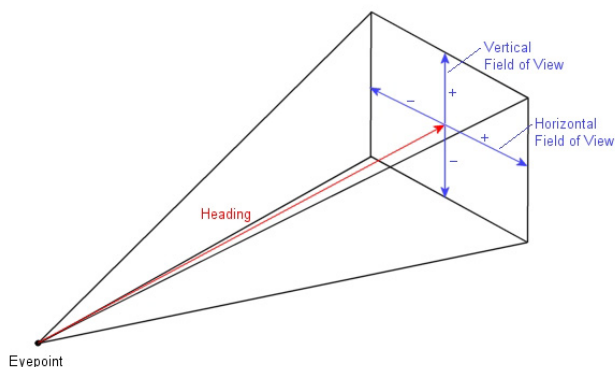
Figure 4-18 Defining Spherical Channel Extents

1. Ensure all required cameras and channels are active. Refer to
    4.4.1 Import Available Cameras and *4.5.1 Import Available Channels*.

2. Select **Spherical** from the **Data Type** drop-down list.

Figure 4-19 Spherical

3. Enter the **Eyepoint (Cartesian)** value.

4. Select each channel, defining the **Heading** and **Field of View**
    information for each.

    NOTE: *All values are specified in degrees.*

Projecting Collimated Spherical Data

Collimated spherical projection is the projection of spherical data onto a mirror which the viewer then sees. In addition to the settings required for spherical data, you must also specify other parameters for collimated projection, such as the position of the mirror relative to the screen, the radius of the mirror, and so on.

1. Ensure all required cameras and channels are active. Refer to *4.4.1 Import Available Cameras* and *4.5.1 Import Available Channels*.

2. Select **Spherical (Collimated)** from the **Data Type** drop-down list.

Figure 4-20 Collimated Spherical

3. Specify the mirror location settings, the radius, and the yaw, pitch, and roll.

4. Specify the eyepoint offset from the mirror.

4.5.4 Global Settings

This section of the Channel Settings Tab is used to specify warp and blend settings, grid resolution, and projector orientation. The information for both warps and blends is stored under one name. You specify whether or not you want to include blend calculations.

Figure 4-21 Global Settings

Saving Warps and Blends

1. In the **Name** field, enter the warp/blend name to be sent and saved to the projector.

2. From the **Location** drop-down list, specify the memory location of the warp/blend.

3. To include blend calculations, select the **Blend Calculations Enabled** check box. If you clear this check box, blend calculations are not done and no blending information is sent to the projectors.

To access the saved warp:

1. Press the MENU button from the projector's built-in keypad or the remote.

   NOTE: *If you do not have a remote, use the up and down arrow keys from the built-in keypad to select a number.*

2. Select 4 CONFIGURATION.

3. Select 8 GEOMETRY AND COLOR.

4. Select 2 KEYSTONE AND WARPING.

5. Select 1 WARP SELECT to access a drop-down list containing all saved warp locations. Each projector can store up to 10 custom warp definitions. Users can select any number from 1 to 10.

6. Press the MENU button again to exit.

To access the saved blend:

1. Press the MENU button from the projector's built-in keypad or the remote.

2. **NOTE:** *If you do not have a remote, use the up and down arrow keys from the built-in keypad to select a number.*

3. Select 4 CONFIGURATION.

4. Select 8 GEOMETRY AND COLOR.

5. Select 4 EDGE BLENDING.

6. Select 1 BLENDING SELECT to access a drop-down menu containing all saved blend locations. Each projector can store up to 5 custom blend definitions. Users can select any number from 1 to 5.

7. Press the MENU button again to exit.

Grid Size

Use the drop-downs to specify the number of grid point to be drawn by the projector (the warp resolution sent down to the projector).

Saving Twist™ File

Specifies the name of the .twist file that is generated by AutoCal. If an absolute path is not provided, the .twist file is generated at the same location as the .cal file.

1. In the **Twist Filename** section of the Channel Settings Tab, click the **Select** button. The save dialog box appears.

2. Enter a filename and click **Save**.

Orientation

Select **Normal** when the projector images are not physically rotated. Use the **Portrait CCW** (counter-clockwise) or **Portrait CW** (clockwise) options when the projector images are physically rotated in the configuration.

Blinders

Indicates if Moto-Blend Blinders are being used or not. If **Blinders** are used, AutoCal needs to move the blinders out of the way when doing a calibration.
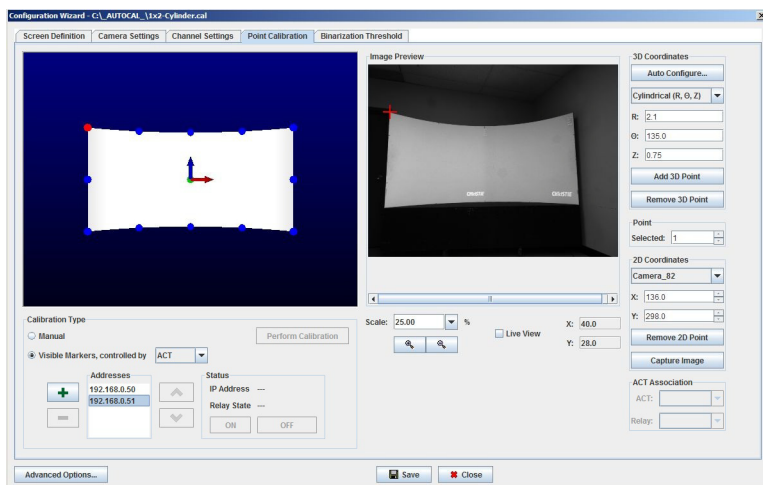
4.6   Point Calibration Setup Procedures

Figure 4-22 Point Calibration Tab

Ensure that you have completed these procedures before point calibration:

- *4.3 Screen Definition Setup Procedures*
- *4.4 Define Camera Settings*
- *4.5.1 Import Available Channels*
- *4.5.3 Define Channel Extents*
- *4.5.4 Global Settings*

4.6.1 Define Points

For flat, cylinder, and sphere screen geometries see *Add Points Automatically on page 4-21*.

Custom screen geometry files (.wrl) may include calibration points which are imported on the Screen Definitions tab, see *4.3.4 Custom Screen Geometry*. If the .wrl file does not include calibration points, see *Add Points Manually on page 4-22*. The Auto Configure function is not available for custom screen geometry.

Add Points Automatically

Adding points with Auto Configure removes existing points and mapping, and add a new grid of points.

1. On the Point Calibration Tab (Figure 4-22), click **Auto Configure**. The Auto Configure dialog box appears.
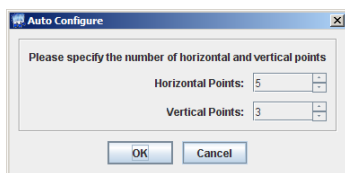
Figure 4-23 Auto Configure - Define Points

2. Specify the number of horizontal and vertical points to be used and click **OK**.

   The points appear in the 3D preview window.

   NOTE: *To adjust the position or orientation of the 3D preview, click on the image and drag. To adjust the position of a single point, select the point and adjust the XYZ values in the 3D Co-ordinates panel.*

Add Points Manually

1. Click **Add 3DPoint** on the Point Calibration Tab.

   A point is added to the center of the image in the left preview window.

2. Use the **3D Coordinates** fields to assign a position for each point.

NOTE: *To avoid multiple overlapped points in the center, define the position for each point as it is added.*

Delete Points

Click **Auto Configure** from the **Point Calibration** tab to access the **Auto Configure** dialog box. Enter the specific horizontal and vertical points, and press **OK.** Each time points are added using this option, any previous points are lost.

   OR

Select a specific point in the 3D preview window and click **Remove 3D Point**. The minimum number of points required is 4.

4.6.2 Map Points

Complete the following steps for each camera in the system.

NOTE: *Do **not** map points with **Live View** switched ON.*

1. Click a point in the 3D preview to select it. The point turns red.

2. To move the selected point, change the values in the **XYZ** fields in the 3D Coordinates panel.

NOTE: *The calculation to move a point is based on the option selected in the 3D Coordinates drop-down: Cartesian, Cylindrical or Spherical. See* <u>*Point Calibration Features on page 3-9*</u>*.*

3. From the side panel, click on the **2D Coordinates** drop-down list and select the camera to map the points to.

4. To map the point, change the crosshairs position in the **Image Preview** window:

    • Manually enter an exact position in the **2D Coordinates/XY** fields.

    OR:

    • Use the mouse to reposition the crosshairs. The **XY** coordinates under the Image Preview track the position of the cursor. Left-click to assign the position. The crosshair turns red to indicate the position is mapped. The coordinates of the position are displayed in the **2D Coordinates/XY** fields.

    NOTES: *For greater accuracy, position the cursor where you want to map the point to and press the CTRL key. A window opens with an enlarged image of the section at the cursor position (***Figure 4-24***). Click in the window to place the cursor.*
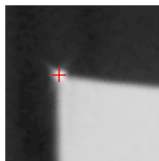

    Figure 4-24 Advanced Zoom

5. Repeat Steps **1** to **4** for each point that requires mapping.

6. To remove a 2D point from being mapped to a 3D point, select a specific point in the 3D preview window and press Remove 2D point. The 2D mapping for this 3D point will be removed.

7. Click **Save** to save the settings.

8. To test the camera calibration, see <u>*4.6.5 Perform Camera Calibration*</u>.

4.6.3 Change Image Scale

Manually enter a value in the **Scale** field or use predefined values from the drop-down list. Image scale can also be adjusted using the mouse wheel.

    OR

Click the **Zoom In** and **Zoom Out** buttons.

4.6.4 Camera Visible Markers

This feature on the Point Calibration Tab enables users to specify the connection method to the Dual Port Network Power Switch which controls the power to the connected visible markers, such as LED screen markers. You can choose to turn the LED screen markers on or off yourself, use a BlackBox network power switch, or use an ACT device. For more information about these settings, see *Point Calibration Features on page 3-9*.

4.6.5 Perform Camera Calibration

1. Ensure the current configuration is saved before beginning the calibration.

2. Click **Perform Calibration**.

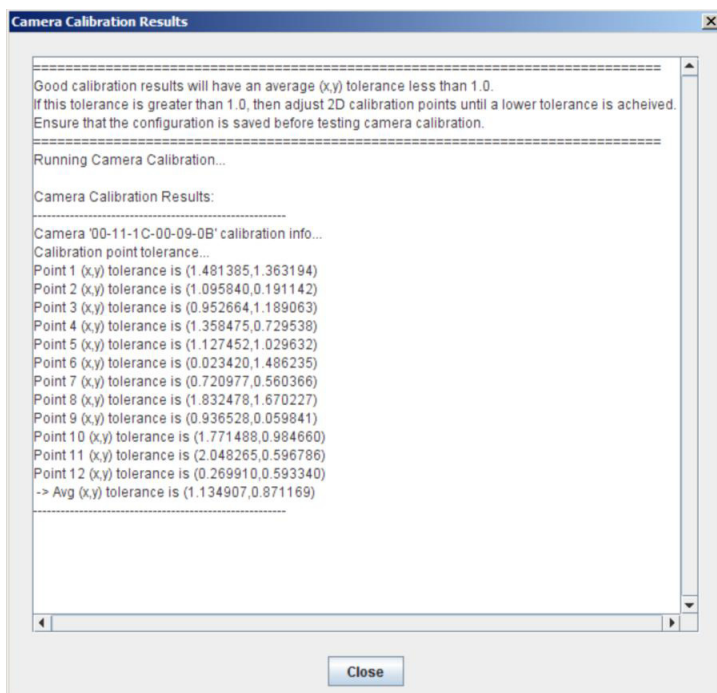   The Camera Calibration Results window provides calibration information for each camera.

Figure 4-25 Camera Calibration Results

If the average (x,y) tolerance for a camera is greater than 1.0 adjust the 2D calibration points until a lower tolerance is achieved.

> **NOTE:** *If Camera Visible Markers are being used, or if improving the 2D calibration points does not reduce the tolerance, check the accuracy of the 3D locations of the calibration points.*

3. If camera calibration is low, perform the confirm system layout test. For details, see .

4.7 Binarization Threshold Setup Procedures

4.7.1 Binarization Threshold and Camera Exposure Adjustments

The Binarization Threshold Tab is used in conjunction with geometry correction. It enables users to define the threshold of the black (dark) and white (bright) pixels of the captured image.

Once a camera is activated from the Camera Settings tab, you can adjust the binarization threshold and camera exposure of the selected camera. To alter the binarization threshold and camera exposure, at least one camera and one projector must be connected and activated. Otherwise, the features on this tab are disabled.

When a binarized image is taken, the projector(s) in the system display a black background with a white grid. (If Camera Markers are selected, the camera visible markers (i.e., screen LEDs) are turned on to select a correct binarization and exposure value to detecting these markers).

The ideal outcome (exposure value and binarization threshold value) is to diminish image background noise and to have all grid points fully captured. **Figure 4-26** illustrates when binarization thresholds are too low or too high, and what users should see when binarization is correctly set up.

> **NOTE:** *AutoCal can automatically determine exposure and binarization threshold settings in most cases. To have AutoCal do this, select **Automatic** under Camera Control on this tab.*

Before completing this procedure, ensure:

*   the screen is defined
*   the required cameras are imported and activated
*   the required channels are imported and activated
*   channel extents are defined
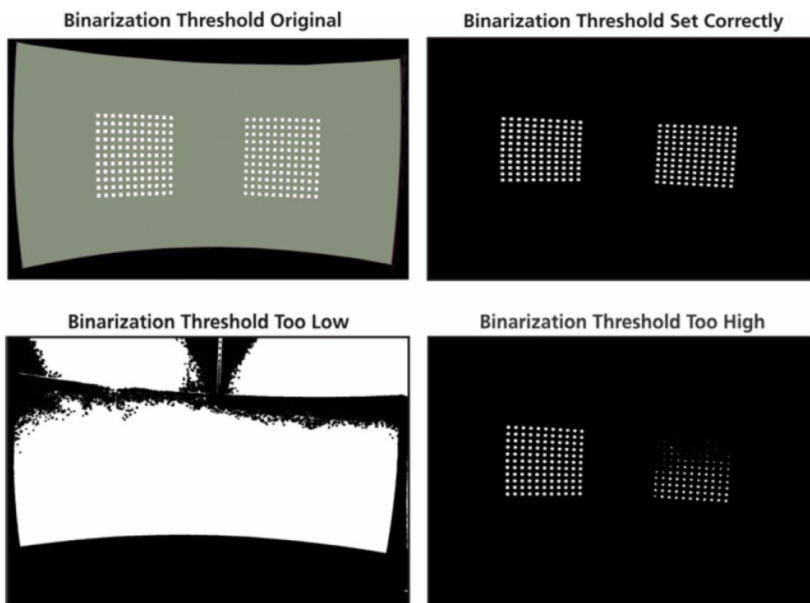*   all points are mapped

Figure 4-26 Binarization Levels

Camera Selection

1. Ensure at least one camera and one channel are connected and selected. For more information, see *4.4.1 Import Available Cameras* and *4.5.2 Remove Channels*.

2. From the drop-down list, select a specific camera.

3. From the **Markers** drop-down list, select from **Grid** or **Camera**. Grid markers is the grid pattern projected by the projectors associated with the selected camera. Camera markers is the visible camera markers specified on the Point Calibration Tab (i.e., LEDs). If visible camera markers are not being used, this option is not available in the list.

4. Once a camera is selected, the image preview displays an image from the selected camera that has been binarized.

4.7.2 Adjust Binarization Threshold / Camera Exposure

Camera Control: Select whether you want **Automatic** or **Manual** control over the camera. AutoCal can automatically determine exposure and binarization threshold settings in most cases, so you should select Automatic. If you select Manual, then the following controls are available:

• **Exposure:** Drag the handle to set the amount of time (micro-seconds) the camera shutter remains open while capturing images.

• **Binarization Threshold:** Drag the handle to adjust binarization threshold. This value determines how bright an image pixel must be before it appears in the binarized image (i.e. before it flips to white).

NOTE: *When multiple cameras are used, binarization and exposure settings must be adjusted individually for each one.*

NOTE: *When making adjustments, the key is to find a balance between the correct exposure and binarization threshold until all ambient light is filtered out and the image displayed shows only the grid points in their sharpest context. It is essential to avoid losing points when making adjustments.*

Change Image Scale

To change the scale of the image, do one of the following:

• Enter a value in the **Scale** field

• Select a value from the **Scale** drop-down list.

• Click the **Zoom In** and **Zoom Out** buttons.

4.8   Main AutoCal Window

The main AutoCal application window (**Figure 4-27**) allows you to choose between doing geometry and blend correction, and/or color and brightness correction.
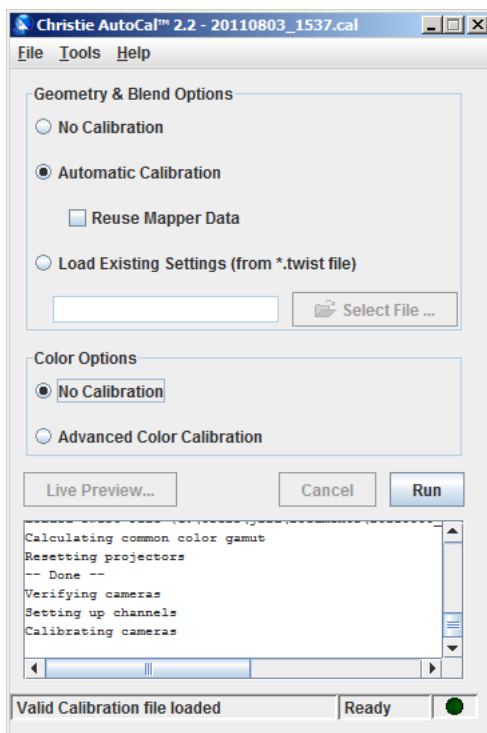
Figure 4-27 Main AutoCal Window

NOTE: *Geometry calibration can only be run if the GEOMETRY feature is enabled by the registered license key. Advanced Color calibration can only be run if the ADVANCED COLOR feature is enabled by the registered license key.*

Geometry and Blend Options

If Automatic Calibration is selected, the information defined in the Configuration Wizard is used for the calibration.

NOTES: 1) *Depending on the options selected, geometric correction is done first, followed by color correction.* **2)** *The calibration can be cancelled, or paused and resumed at any point while a calibration is running.*

If you are making minor configuration changes between calibration attempts, you can skip the mapper stage of the calibration process by selecting **Reuse Mapper Data**. You should only use this feature if the projectors and cameras in your setup have not moved.

If **Load Existing Settings** is selected, the specified .twist file is loaded (Geometry and Blending correction is not done with AutoCal, but the warp and blend information in the .twist file is applied to the projectors on load). This option is used if Color Correction is to be done, but Geometry Correction is not.

Advanced Color Calibration

This uses a color meter in a semi-automated process. See *Section 4.10 Advanced Color Calibration*.

4.9   Run Auto-Calibration

Before initiating automatic calibration, ensure:

• The screen is defined

• The required cameras are imported and activated

• The required projectors are imported and activated

• Channel extents are defined

• All points are mapped

• Binarization and camera exposure levels are set up

1. From the Configuration Wizard, click **Save** to save the current configuration. The main AutoCal window appears (**Figure 4-27**).

2. Specify the geometry and blend options.

   • **No Calibration:** Select this option to skip geometry and blend calibration.

   • **Automatic Calibration:** Select this option to automatically calibrate geometry and blend via auto calibration.

   • **Load Existing Settings:** Select this option to load a previously generated TWIST™ file. Ensure the projector(s) is set up accordingly.

   NOTE: *When you select either Automatic Calibration or Load Existing Settings, warps, blends, and masks are applied to the projector(s).*

3. Specify the color options.

   • **No Calibration:** Select this option to skip color calibration.

   • **Advanced Color Calibration:** Select this feature to color match the projectors using a color meter instead of a camera. For more information, see *4.10 Advanced Color Calibration*.

4. Click **Run** to begin system calibration.

5. The script box on the AutoCal window (**Figure 4-28**) runs each time a calibration file is saved and run. If the calibration file is incorrect, the script box will display the reason for the failure (i.e., no camera enabled).
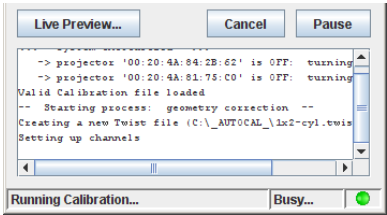

Figure 4-28 Run Calibration Script Box

6. During a calibration, click **Live Preview** to view continually updated images taken during the geometric calibration process (Binarized on Left/Raw on Right).
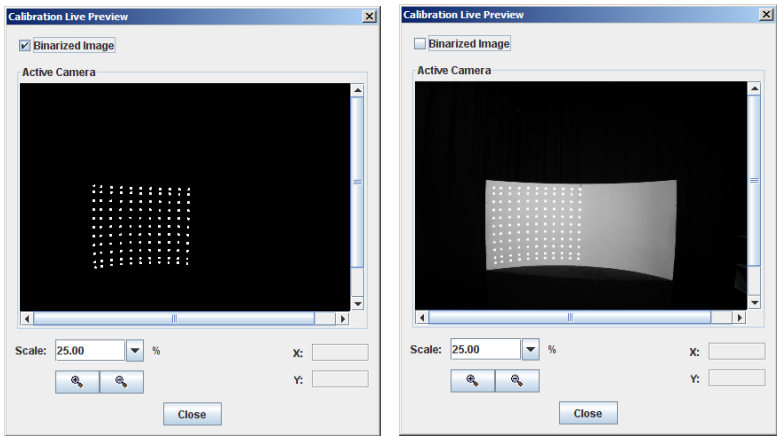

Figure 4-29 Live preview

NOTE: *You can click Cancel and Pause/Resume at any time during a calibration.*

4.10 Advanced Color Calibration

The Advanced Color Calibration feature is used to match the color and brightness of the projectors using a color meter (**Figure 4-30**) instead of a camera. A valid .cal file must be loaded and must contain the information for the projectors that are to be calibrated.

Brightness and color matching ensures that all of your projectors can reach the same brightness and color levels.
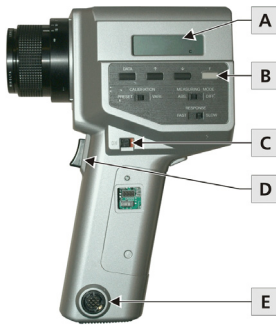
A	Display
B	Function Key
C	Power ON/OFF Switch
D	Trigger
E	Digital Output Terminal

Figure 4-30 Minolta Color Meter Components

NOTE: *This procedure assumes that you are performing both a brightness and color matching calibration. If you are not performing one of these, then the wizard leads you through appropriate steps for your selections.*

1. In the AutoCal window, under Color Options, select the **Advanced Calibration** option and then click **Run**. The Advanced Color Calibration dialog box appears (**Figure 4-31**).
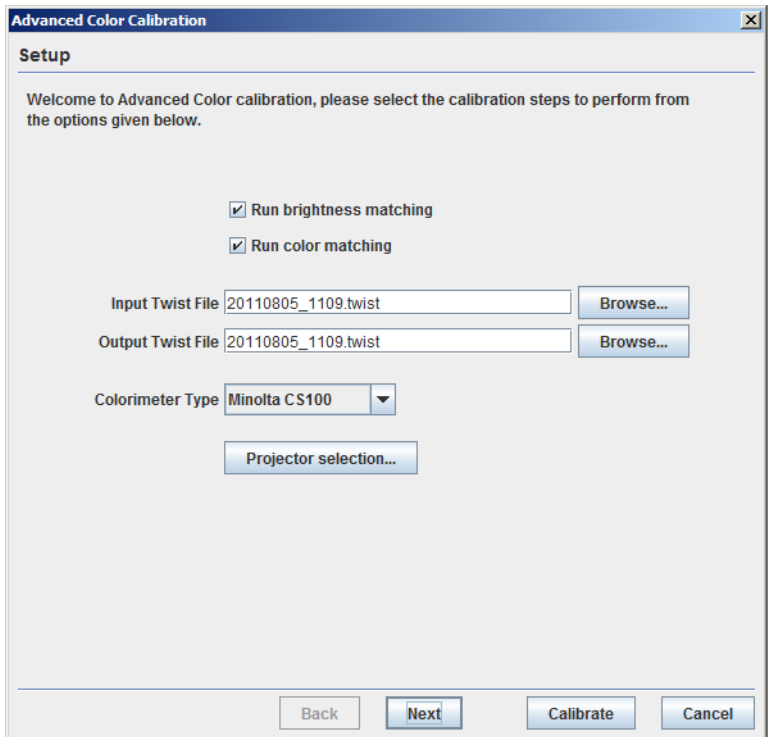
Figure 4-31 Advanced Color Calibration Dialog Box

2. Select one or both of the following options:

   • To have AutoCal perform a brightness matching calibration, select **Run brightness matching**.

   • To have AutoCal perform a color matching calibration, select **Run color matching**.

3. Specify the TWIST input and output files to use. Click **Browse** to locate the files.

4. From the **Colorimeter Type** drop-down list, select the color meter you are using.

5. To select the projector(s) you are going to use in the calibration, click **Projector selection**. The projector selection dialog box appears (**Figure 4-32**).
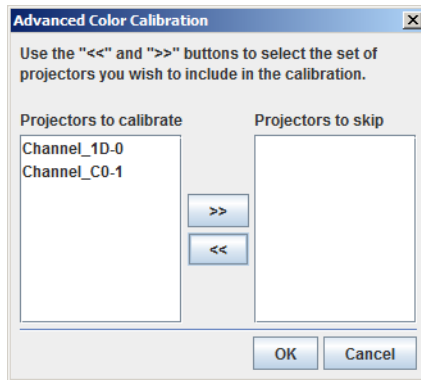
Figure 4-32 Advanced Color Calibration - Projector Selection

6. Specify which projectors to calibrate and which to skip by using the double-arrow buttons to move the projectors into the desired column. When you are finished, click **OK**. If you chose to calibrate brightness, the Brightness Setup window appears (**Figure 4-33**).
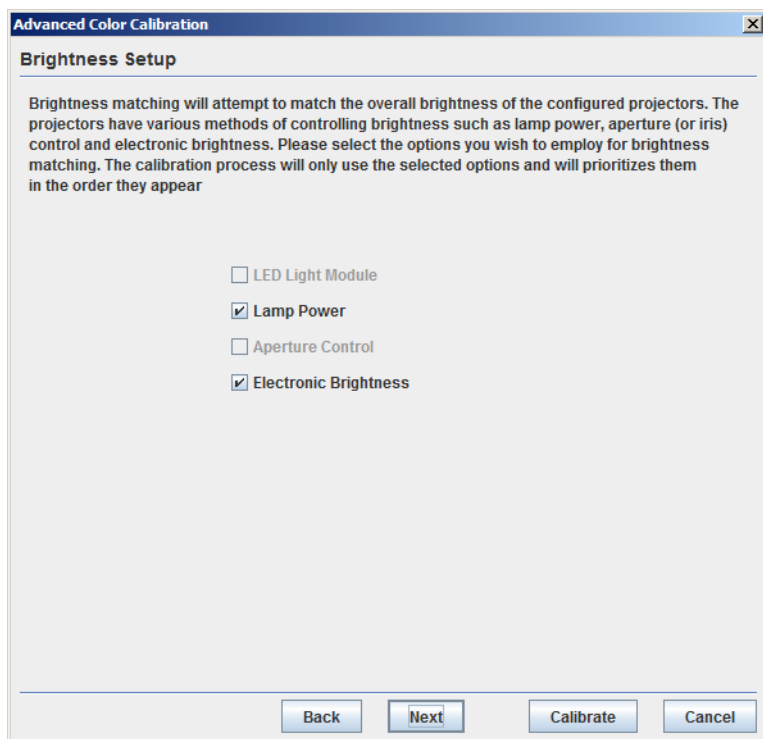
Figure 4-33 Advanced Color Calibration - Brightness Setup

7. Select the options to use for brightness matching, and clear the ones you do not want to use. If a setting is grayed out, it is not available for your projector(s). Click **Next**. If you chose to perform color calibration, the Color Setup window appears (**Figure 4-34**).

Figure 4-34 Advanced Color Calibration - Brightness Setup

8. From the **User Color Entry** drop-down list, select the user-defined color space where you want to save the common color space found by the calibration process. If you want to override the default maximum drive settings for the projector(s), select **Overwrite max drives**. Click **Next**. The Calibrate window appears (**Figure 4-35**).
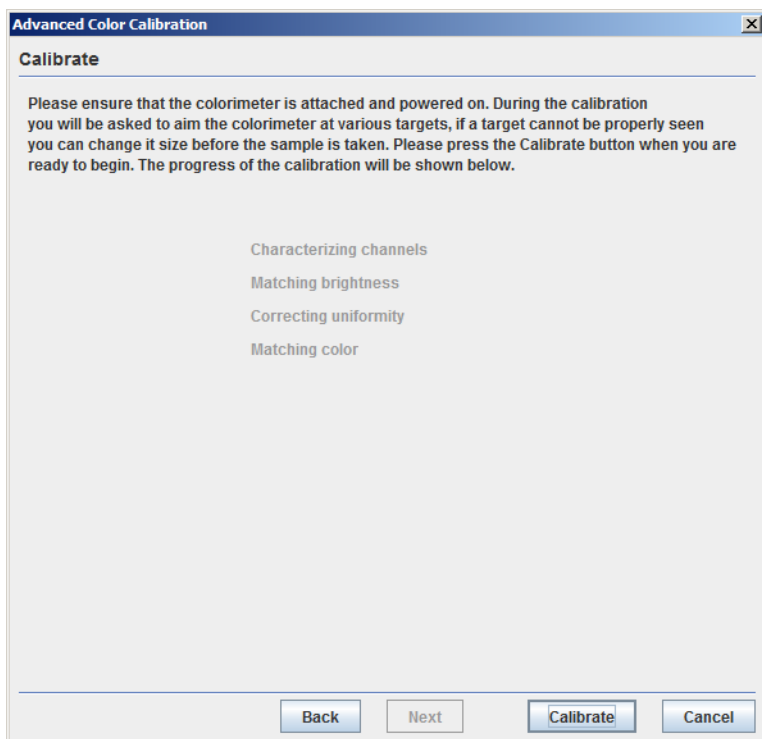
Figure 4-35 Advanced Color Calibration - Calibrate

9. When you have the colorimeter attached and powered on, click **Calibrate** to start the calibration process. A target appears on your screen, and you are prompted to point the colorimeter at it (**Figure 4-36**).
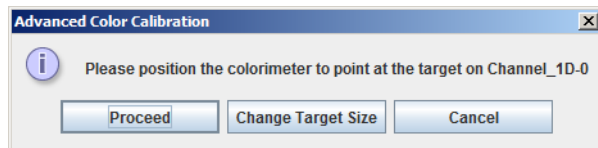

Figure 4-36 Advanced Color Calibration - Proceed with Calibration

IMPORTANT: *When powering the color meter ON ensure the Function key is held down to ensure COMMUNICATION mode is enabled. The letter 'C' is shown on the color meter display when COMMUNICATION mode is ON. Point the meter at the screen and activate the trigger once the target is made.*

10. If necessary, change the size of the on-screen target. Click **Change Target Size**. The Target Size Selector dialog box appears (**Figure 4-37**). Choose the **Width** and **Height** of the target. Click **Apply** and **OK**.
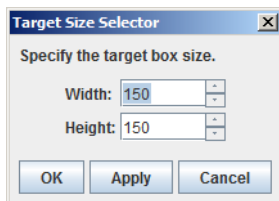

Figure 4-37 Advanced Color Calibration - Target Size

11. Point the colorimeter at the specified target and click **Proceed** to take a measurement from the designated projector. The wizard continues to prompt you to gather information from each projector, and calibrate the brightness and/or color (as specified) of each projector. Continue to click **Proceed** as prompted.

NOTE: *Once Autocal has calibrated brightness and color, it repeats the brightness calibration step to ensure that color matching has not changed any brightness settings.*

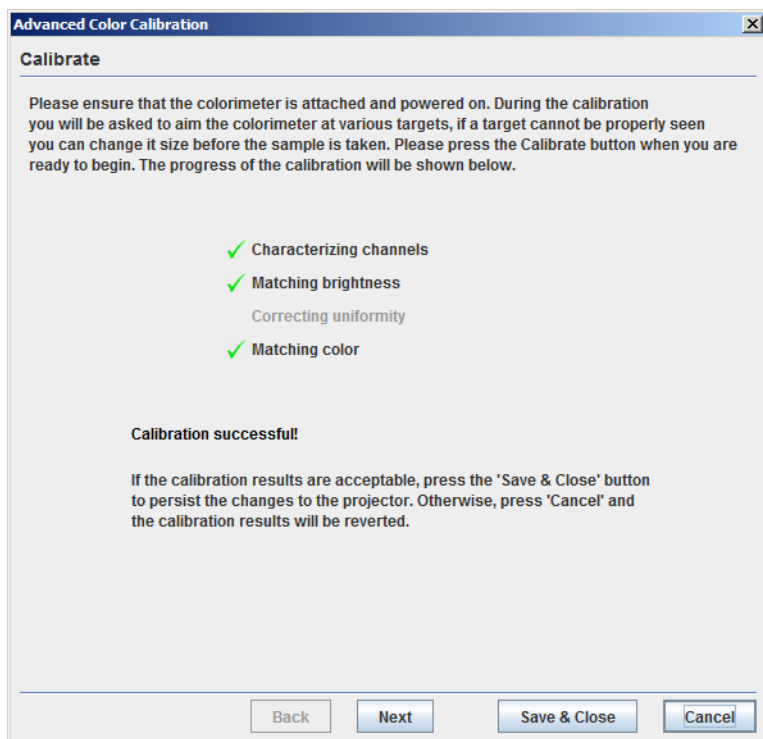12. When the calibration is complete, the wizard shows that it was successful (**Figure 4-38**).

Figure 4-38 Advanced Color Calibration - Success

13. If you are satisfied with the calibration results, click **Save & Close**. The wizard window closes. If you want to view detailed information about the calibration results, click **Next**. The results window appears, showing the Brightness tab (**Figure 4-39**).
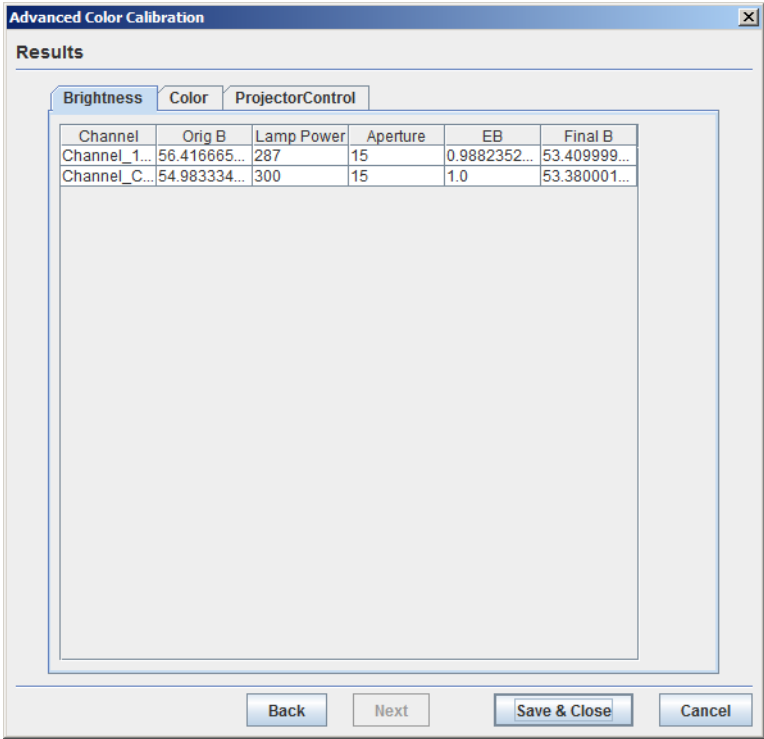
Figure 4-39 Advanced Color Calibration - Results - Brightness

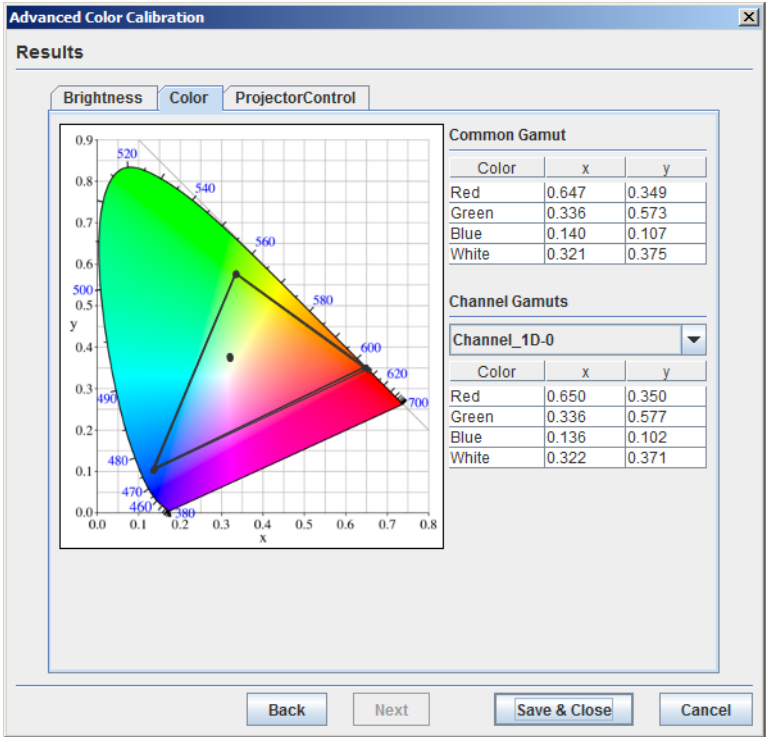14. To view information about the common color gamut achieved by the calibration, click the Color tab (**Figure 4-40**).

Figure 4-40 Advanced Color Calibration - Results - Color

15. To further adjust projector settings, click the Projector Control tab (**Figure 4-41**).
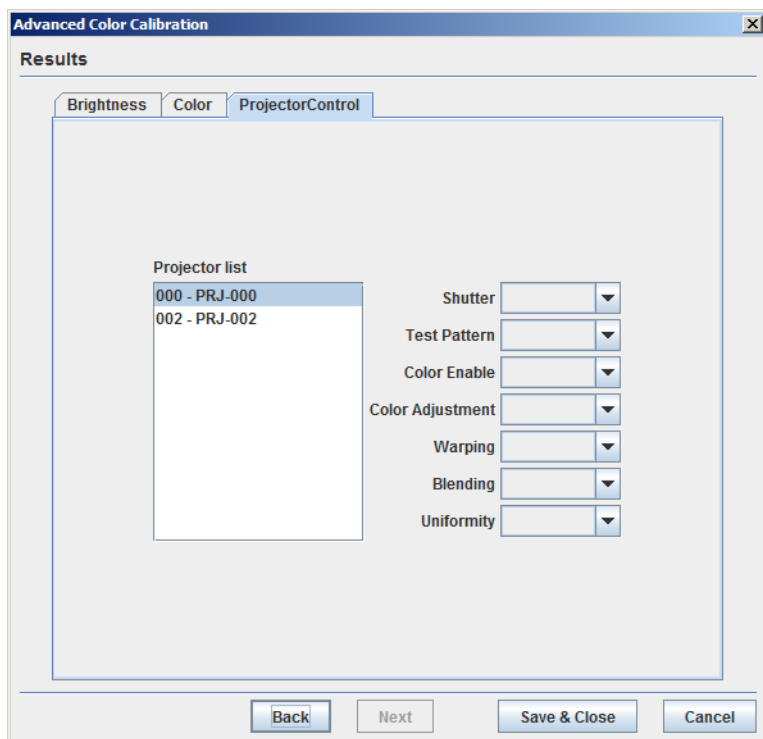
Figure 4-41 Advanced Color Calibration - Results - Projector Control

16. To change projector settings, select the projector(s) from the Projector List and select options from the following drop-down lists. If you select more than one projectors, the changes are applied to all selected projectors.

- **Shutter:** Select whether the shutter is Open or Closed.

- **Test Pattern:** Select which test pattern to display on the projector(s): Off, Grid, Grey 16, White, Grey, Black, Checker, or 13 Point.

- **Color Enable:** Select which color to enable on the projector(s): White, Red, Green, Blue, Yellow, Cyan, or Magenta.

- **Color Adjustment:** Select whether to apply the color adjustment to Max Drives, User 1, User 2, User 3, or User 4.

- **Warping:** Select whether warping is Enabled or Disabled.

- **Blending:** Select whether blending is Enabled or Disabled.

- **Uniformity:** Select whether uniformity is Enabled or Disabled.

4.11 Confirm System Layout

Use this feature to validate that the calibration is setup as desired when a valid calibration file is loaded (Figure 4-42).

For each camera in the system, it super-imposes the boundary of the screen section and channels that it sees. This confirmation step will initiate the automatic ordering algorithm if the Planar (Basic) option is chosen to define the channel extents. For more information, see *4.14 Automatic Ordering Algorithm, on page 4-45*.

1. Click **Tools** > **Confirm System Layout**. Warping/blending is turned OFF, a white test pattern is displayed on all screens and a red bounding box is superimposed for each channel in the image (**Figure 4-42**). A blue bounding box represents the defined screen.
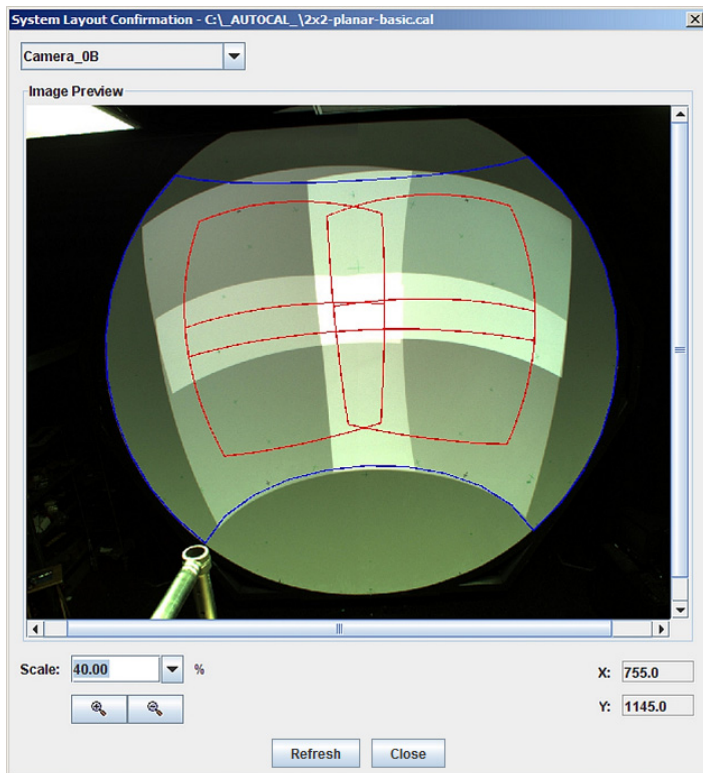

Figure 4-42 Confirm System Layout - 2x2 on Dome

2. Confirm that the inside of the bounding box is within the projected images (white test pattern). By having each of the boxes within the white test pattern it confirms the screens have the correct dimensions, the overlaps are correct and the layout was defined accurately (**Figure 4-43**).
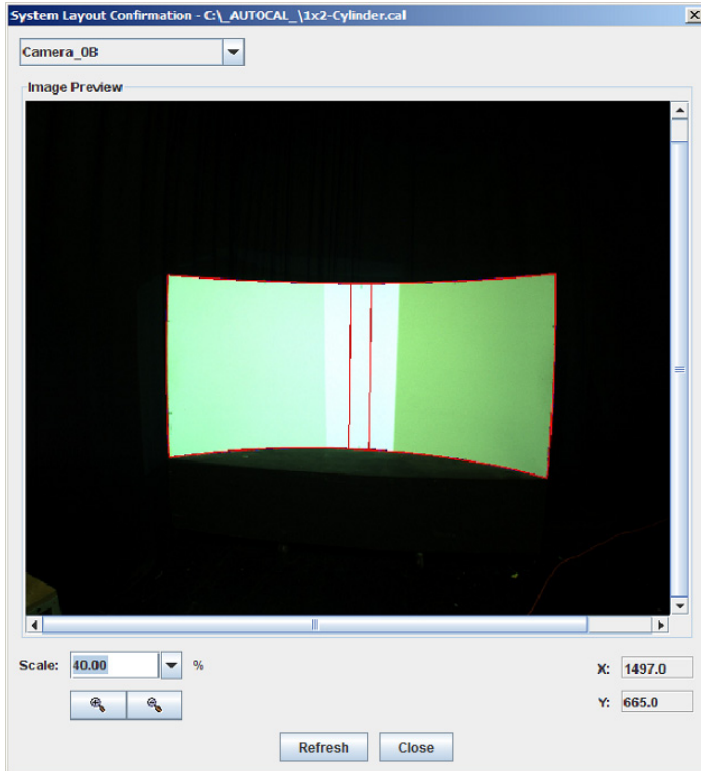

Figure 4-43 System Layout Confirmation

- If the bounding box is not within the white test pattern it indicates the image will not be displayed within the target position.
- If the superimposed image does not match the layout of the physical screen re-calibrate the camera, adjust the horizontal and vertical overlaps, or adjust the physical/target screen parameters.

4.12 Test Pattern

The test pattern generation tool draws a test pattern directly to the projectors (Figure 4-44). Test patterns are useful for verifying that the calibration has generated a correct warp and blend.
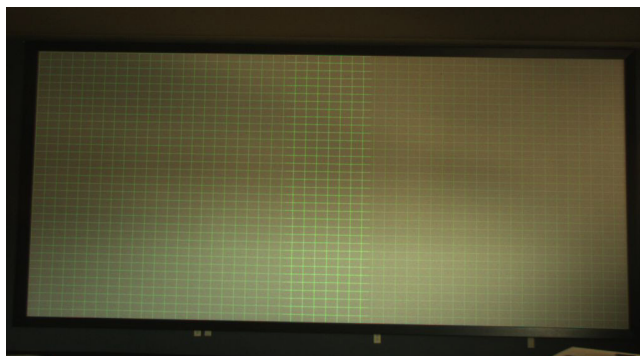
Figure 4-44 Drawn planar test pattern on a 1x2 display

To access the Test Pattern tool dialog box, click **Tools > Test Pattern**.

Depending on the type of calibration that was run, either the spherical or planar test pattern dialog box appears.
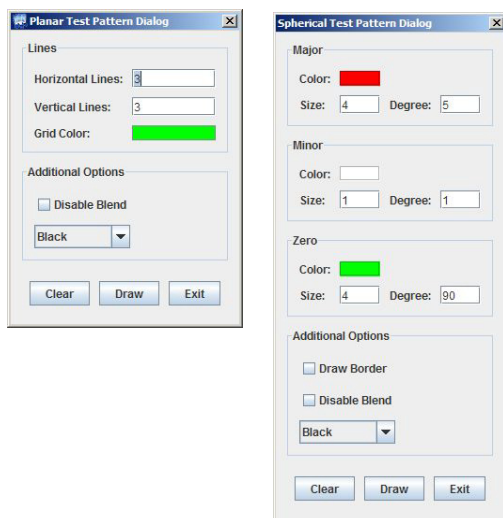

Figure 4-45 Planar Test Pattern dialog box (left) and Spherical Test Pattern dialog box (right)

The Planar Test Pattern Tool controls:

• The number of horizontal and vertical lines drawn over the final display.

• The color of the lines.

• Which internal test pattern to draw the pattern over.

• Whether the blend is disabled.

NOTE: *Figure Figure 4-44 is an example of a planar test pattern that was drawn for a 1x2 display.*

The Spherical Test Pattern tool controls:

- Which degree lines should be drawn, their color and point sizes
- Which internal test pattern to draw the pattern over
- Whether the blend is disabled
- Whether a border should be drawn around the warp boundary.

4.13 Tweak Warp

After completing a geometric calibration, you have the option of tweaking the warp generated by the AutoCal Software.

1. Click **Tools > Tweak Warp**.

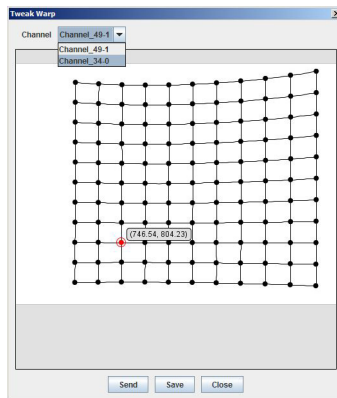   The Tweak Warp dialog box appears.

Figure 4-46 Tweak Warp dialog box

1. From the **Channel** drop-down list, select the channel to tweak the warp on.

2. Select the desired grid point to adjust. The selected grid point is shown on the projector.

   NOTE: *Only one point can be selected at a time.*

3. Move the point:
   - Click and drag the selected point with the mouse.
   - **CTRL-arrow-key** moves the selected point 1 pixel.
   - **ALT-arrow-key** moves the selected point 10 pixels.
   - **CTRL-ALT-arrow-key** moves the selected point 0.1 pixels.

4. To preview the warp changes click **Send**.

5. To save the warp changes to the projector and the generated .twist file, click **Save**.

4.14 Automatic Ordering Algorithm

The automatic ordering algorithm attempts to auto-order the projectors in the system to the layout defined within the AutoCal calibration. This algorithm is only used in a single-camera setup in Planar (Basic) mode. When executed, it displays a test pattern of 4 large grid points for each channel in the system.

Figure 4-47 Auto-ordering algorithm, raw grid

Image processing sorts the location of each channel with respect to the desired layout. For example, if the defined layout is a 1x2 using 2 projectors, the auto-ordering algorithm attempts to determine which projector is in the (1,1) location and which projector is in the (1,2) location.

Running a geometric calibration as well Confirm System Layout use this algorithm. If the image displayed by Confirm System Layout is not correct (i.e., a red channel boundary is displayed for only one of the 2 channels, or the boundary is in the wrong location relative to the physical screen) it is likely an issue with the auto-order algorithm detecting an incorrect setup. Adjustments to the screen layout, physical/target screen parameters, overlap percentages, camera calibration, binarization threshold, number of channels in the system, etc. might need to be made to correct any issues that may arise. For details, open the generated AutoCal.log file. See *5.8 Location of Generated Images and Log Files*.

4.15 Online Help

To access the online help, click **Help > Christie AutoCal 2.2 Help** (**Figure 4-48**).
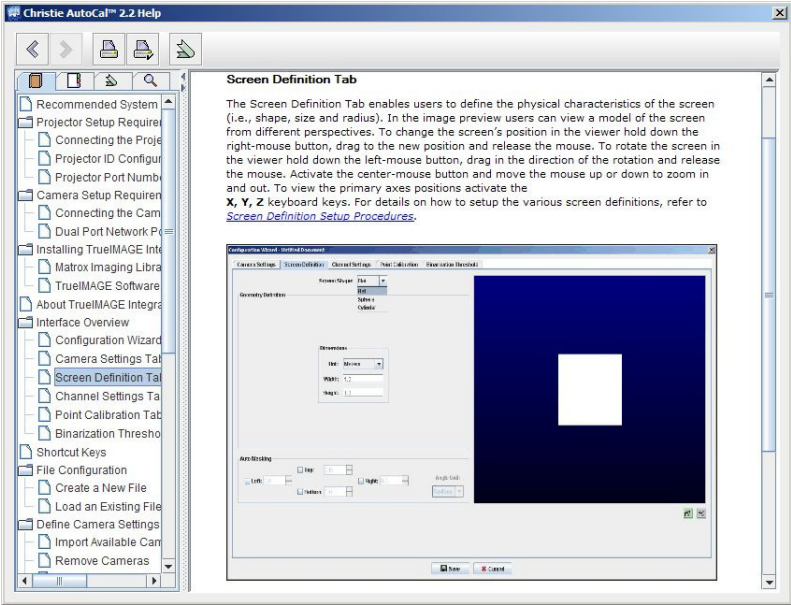

Figure 4-48 Online Help

5 Troubleshooting

5.1 Unable to Search for Cameras or Channels

- Ensure PC network connectivity.
- Check cable connections (PC, camera, projectors, etc.).
- Ensure the computer is on the same subnet as the camera/projector.
- Check the Ethernet firmware version on the projector.
- Ensure that no other Christie software application is running.

5.2 Unable to Connect to Camera

Ensure the camera is connected to a dedicated router with DHCP enabled. The camera should be assigned an IP address automatically.

If the Genie camera cannot be detected on the network, a camera recovery step can be performed:

1. Ensure any wireless network connections have been disable.

2. Use an Ethernet cable to plug the Genie Camera directly into your machine's network port. It should be plugged into the only enabled NIC – disable all other NICs.

3. To launch the Genie Camera Network Configuration Tool, click **Start > Programs > DALSA > Sapera Network Imaging Package > DALSA Network Configuration Tool**.

4. Click **Advanced > Recover Camera**.

5. If the camera is found, enter in the MAC address for the camera. The MAC address is located on the bottom of the camera.

6. Set the camera to either DHCP or Persistent IP mode depending on your current network configuration.

7. Press **Recover Camera**.

5.3   Projector Not Responding

- •   Check power.
- •   Check cable connections.
- •   Check ability to search for projectors.

5.4   Invalid Calibration File Loaded

A .cal file is valid when the following conditions are met:
- •   The selected camera is currently on the network,
- •   the screen has been defined,
- •   each projector within the configuration is currently on the network,
- •   each camera has the minimum number of calibration points (4 for flat screen / 6 for non-flat screen), and
- •   binarization and camera exposure values have been specified.

5.5   High Average (x,y) Tolerance During Camera Calibration

1. If the (x,y) tolerance is greater than 1.0 adjust the 2D calibration points, via the image preview until a lower tolerance is achieved.

2. If the tolerance remains greater than 1.0 after adjusting the 2D calibration points:
    - •   ensure screen dimensions are correct.
    - •   ensure 3D calibration points are defined accurately.
    - •   ensure proper lens is selected from the **Lens** drop-down list.

5.6   Grid Markers Are Not Drawn

When connected serially to projectors, grid markers may not be drawn when **Show** is pressed. This likely will occur when a grid size greater than 7x7 is selected in the **Addition Options** dialog. If this occurs, select a grid size of 7x7 before running calibration.

5.7 Genie Camera Status

Table 5.1 Genie Camera Status outlines the camera status of the Genie camera.

Table 5.1 Genie Camera Status

LED	Status
Blue/Solid	IP address assigned
Blue/Slow	Waiting for IP address
Blue/Fast	Ethernet cable connected
Green/Solid	Application linked to camera
Green/Slow	Trigger acquisition in progress
Green/Fast	Acquisition in progress
Red/Slow	Camera initialization problem
Red/Fast	Camera overheating

5.8 Location of Generated Images and Log Files

AutoCal generates images and log files which may be useful when troubleshooting.

Log files:

To view log files, select **Tools > Diagnostics > Show Logs Folder**.

Images:

To view image folder, select **Tools > Diagnostics > Show Images Folder**.

5.9 Frequent Time-outs

Check that Network Routing is set to Separate. See *2.2.3 Projector Network Configuration*.

Numerics

A

B

C

E

F

G

I

L

M

O

P

S

000-102752-01

ASSY SFW AutoCal v2.2

Corporate offices

USA – Cypress
ph: 714-236-8610

Canada – Kitchener
ph: 519-744-8005

Worldwide offices

United Kingdom
ph: +44 118 977 8000

France
ph: +33 (0) 1 41 21 00 36

Germany
ph: +49 2161 664540

Eastern Europe
ph: +36 (0) 1 47 48 100

Middle East
ph: +971 (0) 4 299 7575

Spain
ph: + 34 91 633 9990

Singapore
ph: +65 6877-8737

Beijing
ph: +86 10 6561 0240

Shanghai
ph: +86 21 6278 7708

Japan
ph: 81-3-3599-7481

South Korea
ph: +82 2 702 1601

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